

PROJECT MANUAL

2019 WPCF REHABILITATION ACADEMY CREEK

Brunswick, Georgia

for

Brunswick-Glynn Joint Water and Sewer Commission

March 2020

Construction Documents

Prepared By

GMC

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GMC PROJECT NUMBER: CSAV190007



2019 WPCF REHABILITATION ACADEMY CREEK
FOR THE
BRUNSWICK-GLYNN COUNTY JOINT WATER & SEWER COMMISSION
GMC PROJECT NO. CSAV190007

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DOCUMENT 00110

INSTRUCTIONS TO BIDDERS

INTENTION: It is intended the Instructions to Bidders, General Conditions, Supplementary Conditions, Technical Specifications and Construction Drawings shall cover the complete work to which they relate.

ARTICLE 1 DEFINED TERMS: In addition to the terms defined in the General Conditions, (EJCDC C-700) (2007), additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof.

- 1.1. **Bidder** - One who submits a Bid directly to Owner as distinct from a sub-bidder, who submits a bid to a Bidder. For this project, all bidders will have to submit a **pre-qualification application** for consideration no later than **12:00 NOON EST on Tuesday, June 21, 2020**. The list of Pre-qualified Constructors for 2019 WPCF Rehabilitation Academy Creek, Project No. 906 will be published by **5:00 P.M. EST on Thursday, July 20, 2020**.
- 1.2. **Successful Bidder** - The lowest, responsible, and responsive Bidder to whom Owner (based on Owner's evaluation as hereinafter provided) makes an award.
- 1.3. **Bid** - A complete and properly signed offer to execute work for the prices stipulated in Bid Form and submitted in accordance with the Bidding Documents.
- 1.4. **Addenda** - Graphic or written documents issued by Engineer prior to the opening of Bids issued to clarify, revise, add to, or delete information in the original bidding documents or in previous addenda.

ARTICLE 2 BID FORM: All Bids must be made upon the bid form hereto annexed and shall state

the amount bid for each item shown, and all bids must be for materials and work called for in the specifications. **Bids** from **pre-qualified** firms are due no later than **12:00 NOON EST on Tuesday, September 1, 2020** at the BGJWSC Headquarters, 1703 Gloucester Street, Brunswick, GA 31520. All questions must be submitted in writing to pcrosby@bgjwsc.org no later than **5:00 P.M. EST on Monday, August 17, 2020**. Answers to all written questions will be sent via email to all registered, pre-qualified bidders via addendum and posted on the BGJWSC website.

- 2.1 The Bid Form is included with the Bidding Documents; Copies of all bid documents may be found on the BGJWSC website utilizing the link below:
<https://www.bgjwsc.org/departments/procurement/>
- 2.2 All blanks on the Bid Form must be completed by printing in black ink or by typewriter.
- 2.3 Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.
- 2.4 All names must be typed or printed in black ink below the signature.
- 2.5 The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form.)
- 2.6 The address and telephone number for communications regarding the Bid must be shown.

ARTICLE 3 PRE-QUALIFICATIONS OF BIDDERS:

00110-2

- 3.1 Only Pre-Qualified Bidders will be allowed to bid. This will be bidders that have submitted an application for pre-qualification, been approved and listed on the BGJWSC List of Pre-qualified Contractors for 2019 WPCF Rehabilitation Academy Creek, Project No. 906 to be released on **Thursday, July 30, 2020.**

ARTICLE 4 COPIES OF BIDDING DOCUMENTS:

- 4.1 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 4.2 Owner and Engineer in making copies of Bidding Documents available for a non-refundable deposit do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

ARTICLE 5 EXAMINATION OF BIDDING DOCUMENTS, OTHER DATA, AND MANDATORY SITE VISIT:

- 5.1 It is the responsibility of each Bidder before submitting a bid:
- 5.1.1 To examine and study thoroughly the Bidding Documents and other related data identified in the Bidding Documents;
- 5.1.2 To visit the work site to ascertain by inspection pertinent local conditions such as location, character and accessibility of the site including existing surface and subsurface conditions in the work area; availability of facilities, location and character of existing work within or adjacent thereto, labor conditions, etc. A **mandatory site visit** is scheduled for **10:00 a.m. EST on Thursday, August 6, 2020** at the plant site, 2909 Newcastle Street, Brunswick, GA 31520. **All pre-qualified prime contractors must have at least one representative at this site visit.** Additional representatives from the subcontractor and vendor pool are also welcome to attend. In observance of current COVID-19 guidelines, appropriate social distancing protocols will be in place for this event. Pre-registration via email is required for all attendees. Please email Pam Crosby at pcrosby@bgjwsc.org no later than **12:00 noon on Tuesday, August 4, 2020** to register and confirm a spot for this event.
- 5.1.3 To become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the Work;
- 5.1.4 To obtain and carefully study (or assume responsibility for doing so) all addition or supplementary examination investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including any specific means, methods, techniques, sequences, and procedures of construction expressly required of the bidding documents, and safety precautions and programs incident thereto;

- 5.1.5 To study and carefully correlate Bidder's knowledge and observations with the Bidding Documents and such other related data; and
 - 5.1.6 To promptly notify Engineer of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between the Bidding Documents and such other related documents;
 - 5.1.7 to agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times and in accordance with the other terms and conditions of the Bidding Documents;
 - 5.1.8 To become aware of the general nature of the work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents;
 - 5.1.9 To determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- 5.2 The Owner shall make available to all prospective bidders, previous to receipt of bids, information that it may have as to sub-soil conditions and surface topography at the work site. Such information shall be given as the best factual information available without being considered as a representation of the Owner.
- 5.3 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 5, that without exception, the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by ENGINEER are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 6 OMITTED

ARTICLE 7 INTERPRETATIONS AND ADDENDA:

All questions about the meaning or intent of the Bidding Documents are to be directed to Procurement Director, Pam Crosby. The person submitting the request shall do so in writing via email, pcrosby@bgjwsc.org and be responsible for its prompt delivery. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by the Procurement team as having received the Bidding Documents. Questions received after the deadline noted in the invitation to bid may not be answered.

Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

- 7.1 Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer. All Addenda will be emailed to registered bidders and posted on the JWSC website. Bidders are advised to review these postings and acknowledge each addenda in their bid submission package.

ARTICLE 8 BID SECURITY:

- 8.1 Each Bid must be accompanied by Bid security made payable to Owner in an amount of five percent of Bidder's maximum Bid price and in the form of a certified or bank check or a Bid Bond (on form attached, if a form is prescribed) issued by a surety company licensed in **Georgia** with an "A" minimum rating of performance and a financial strength of at least five times the contract price as listed in the most current publication of "Best's Key Rating Guide Property Liability."
- 8.2 The Bid security of Successful Bidder will be retained until such Bidder has executed the Agreement, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Agreement or the sixty-first day after the Bid opening, whereupon Bid security furnished by such bidders will be returned. Bid security with Bids that are not competitive will be returned within seven days after the Bid opening.

ARTICLE 9 CONTRACT COMPLETION TIME: The number of days within which, or by which the Work is to be (a) Substantially Completed and (b) also completed and ready for final payment are set forth in the Agreement. Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 10 SUBSTITUTE AND "OR-EQUAL" ITEMS:

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

ARTICLE 11 SUBCONTRACTORS, SUPPLIERS, AND OTHERS:

- 11.1 Each bid must be accompanied by a list of Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity. If OWNER or ENGINEER, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, OWNER or ENGINEER may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, without an increase in the Bid.
- 11.2 If apparent Successful Bidder declines to make any such substitution, OWNER may award the Contact to the next lowest Bidder proposing to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which OWNER or ENGINEER makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to revocation of such acceptance after the Effective Date of the Agreement as provided in paragraph 6.06 of the General Conditions.
- 11.3 CONTRACTOR shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom CONTRACTOR has reasonable objection.

ARTICLE 12 SUBMITTAL OF BIDS: Bids shall be submitted at the time and place indicated in the Invitation to Bid, and shall be enclosed in a sealed opaque envelope, marked with the project title, and name and address of Bidder, and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. Contractor license number(s) shall be written on the face of the bid envelope. One (1) hard copy of original bid, four (4) hard copies and (1) electronic (USB or CD) is required.

ARTICLE 13 MODIFICATION AND WITHDRAWAL OF BIDS:

- 13.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of bids.
- 13.2 If, within twenty-four hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner there was a material and substantial mistake in the preparation of its Bid, Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, Bidder will be disqualified from further bidding on the Work to be provided.

ARTICLE 14 OPENING OF BIDS: Bids will be opened and (unless obviously non-responsive) read aloud publicly at the place where Bids are to be submitted. An abstract of the amount of the base Bids and major alternates (if any) will be made available to Bidders after the opening of Bids on the JWSC website: <https://www.bgjwsc.org/departments/procurement/>

ARTICLE 15 ACCEPTANCE OF BIDS: Bids may not be withdrawn (except as noted in Paragraph 13) after the time set for the opening of Bids. Bids will remain subject to acceptance for 60 days after the day of the Bid opening, but the Owner may, in its sole discretion, release any Bid and return the Bid security prior to expiration of the acceptance period.

ARTICLE 16 AWARD OF CONTRACT:

16.1 Owner reserves the right to reject any or all Bids, including without limitation, the rights to reject any or all nonconforming, nonresponsive, unbalanced or conditional Bids and to reject the Bid of any Bidder if Owner believes it would not be in the best interest of the Project to make an award to a Bidder, whether because the Bid is not responsive, or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Owner.

16.2 Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.

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

The Owner will also consider whether the Bidder involved:

- a) Maintains a permanent place of business;
- b) Has adequate plant and equipment to do the work properly and expeditiously;
- c) Has suitable financial status to meet obligations incidental to the work;
- d) Has appropriate technical experience.

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

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

16.6. If the contract is to be awarded, it will be awarded to the Bidder whose evaluation by Owner indicates the award will be in the best interest of the Project.

16.7. If the contract is to be awarded, Owner will give Successful Bidder a Notice of Award within 60 days after the day of the Bid opening.

ARTICLE 17 MODIFICATIONS OF QUANTITIES: If the lowest bona fide Bid exceeds the money available for the Work, the Owner reserves the right to delete enough of the Work to bring the cost within the available funds. The Owner also reserves the right to delete whichever items or portions of items considered to be in the best interest of the Owner.

ARTICLE 18 CONTRACT SECURITY: The General Conditions and Supplementary Conditions set forth Owner's requirements as to performance and payment bonds. When the Successful Bidder delivers the executed Agreement to the Owner, it must be accompanied by the required performance and payment bonds.

ARTICLE 19 SIGNING THE AGREEMENT: When the Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within 15 days thereafter, Contractor shall sign and deliver the required counterparts of the Agreement and attached documents to Owner with the required Bonds. Within 10 days thereafter, Owner shall deliver one fully signed counterpart to Contractor.

ARTICLE 20 LAWS AND REGULATIONS: The Contractor shall comply with local, District, County, State, and Federal laws applicable to the work.

The Contractor shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 as amended through January 1, 2004 (PL 91-596) and under Section 107 of the Contract Work and Safety Standards Act (PL) 91-54). The regulations are administered by the Department of Labor and the Contractor shall allow access to the project to personnel from this Department.

ARTICLE 21 CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE: Contractor shall not commence work under this contract until obtaining all the insurance required by the Supplementary Conditions.

ARTICLE 22 TERMINATION OF CONTRACT: If the Owner is made to stop construction of the work because of an order from a Court or State Department, the contract shall be terminated. Payment will be made for work completed and a proration of the work underway, materials stored, and for the overhead and profit of the completed work and work underway. Payment will not be made for anticipated profit and overhead on work not completed or underway.

DOCUMENT 00313**BID FORM**

PROJECT IDENTIFICATION: **2019 WPCF REHABILITATION ACADEMY CREEK**

CONTRACT IDENTIFICATION: **PROJECT NUMBER: 906**

THIS BID IS SUBMITTED TO: **BGJWSC**

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the Bid Times 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 Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 10 days after the day of Bid opening, or for such longer period of time BIDDER may agree to in writing upon request of OWNER.
3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:
 - a. BIDDER has examined and carefully studied the Plans and Specifications for the work and contractual documents relative thereto, and has read all Technical Provisions, Supplementary Conditions, and General Conditions, furnished prior to the opening of Bids and can fulfill the requirements of the work to be performed.
 - b. BIDDER further acknowledges hereby receipt of the following Addenda:

Please include signed copies of all addendums.

ADDENDUM NO.	DATE

- c. BIDDER has visited the site and become familiar with and is satisfied as to the general, local and site conditions possibly affecting cost, progress, performance and furnishing of the Work;
- d. BIDDER is familiar with and is satisfied as to all federal, state, and local Laws and Regulations possibly affecting cost, progress, performance and furnishing of the Work.

- e. BIDDER has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structure at or contiguous to the site (except underground Facilities) have been identified in the Supplementary Conditions. BIDDER acknowledges such reports and drawings are not Contract Documents and may not be complete for BIDDER's purposes. BIDDER acknowledges OWNER and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site. BIDDER has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning 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 or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by BIDDER and safety precautions and programs incident thereto. BIDDER does not consider any additional examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Bidding Documents.
 - f. BIDDER is aware of the general nature of Work to be performed by Owner and others at the site relating to Work for which this Bid is submitted as indicated in the Bidding Documents.
 - g. BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports and drawings identified in the Bidding Documents and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
 - h. BIDDER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies BIDDER has discovered in the Bidding Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.
 - i. This bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.
4. BIDDER will complete the Work in accordance with the Contract Documents for the following price(s):

Bid Form

**BGJWSC NORTH MAINLAND PHASE II
2019 WPCF REHABILITATION ACADEMY CREEK**

Bid item	Description	Qty	Units	Unit Price	Extended
1	Performing all of the 2019 WPCP Rehabilitation – Academy Creek work including, but not limited to, Yard Piping Improvements, Replacement of exiting Influent Bar Screens, Headworks Odor Control and Treatment System, Miscellaneous gate replacement, chemical feed modifications and Plant-wide fiber optic network, electrical system improvements etc. all as described in the specifications	1	LS		\$
2	Major Equipment:				
	Mechanical Br Screen (Section 46 21 13) Mfr:_____	1	LS		
	(b) Odor Control Biofilter (Section 44 31 21), Mfr:_____	1	LS		
3	Stormwater Monitoring				
	(a) Monitoring Site (establishing construction and operating site, prepare and submit NOI and NOT, and all LDA fees)	1	LS		
	(b) Sampling Events	12	EA		
4	Lump Sum Allowance for Spare Parts	1	LS		\$15,000.00
5	Lump Sum Allowance for Tertiary Disk Cloth Filter Equipment	1	LS		\$1,250,000.00

6	Lump-Sum Allowance for instrumentation and SCADA integration associated with the Plant Rehabilitation	1	LS		\$ 446,500.00
Addition Work (If ordered by Engineer under Item No. 1 (to cover authorized changes in scope of Lump Sum Work))					
7	Excavation and Backfill				
	(a) Hand, Dry	100	CY	\$	\$
	(b) Hand, Wet and Dewatering	100	CY	\$	\$
	(c) Machine, Dry	100	CY	\$	\$
	(d) Machine, Wet & Dewatering	100	CY	\$	\$
	(e) Crusher Run Stone backfill (including undercutting and removal of unsuitable soils, backfilling with stone and geotextile fabric)	400	CY	\$	\$
8	Concrete Work				
	(a) Class A Concrete (in-place)	100	CY	\$	\$
	(b) Reinforcing Steel (in-place)	1000	LBS	\$	\$
	(c) Constructed forms	200	SF	\$	\$
9	Ductile Iron Pipe in Place (Ceramic Epoxy lining)				
	(a) 24" DIP	10	LF	\$	\$
	(b) 30" DIP	10	LF	\$	\$
	(c) 42" DIP	10	LF	\$	\$
10	Ductile Iron Pipe Fittings (Ceramic Epoxy Lining)				
	(a) Bell & Spigot	0.2	Ton	\$	\$
	(b) Mechanical Joint	0.5	Ton	\$	\$
	(c) Flanged	0.2	Ton	\$	\$
	(d) 8" Restrained Joints	12	EA	\$	\$

TOTAL BASE BID, items 1 through 9 inclusive, the amount of: _____ Dollars (\$_____).

ALTERNATES:

The price for each Alternate will be the amount added to the Base Bid if OWNER selects the Alternate. Alternates MAY be applied in any order the OWNER deems beneficial. The Bid Price for each Alternate represents a final contract price inclusive of contractor overhead, profit, taxes and freight:

Alternate 1:

Alternate No. 1 generally consists of addition of Chemical Media Odor Polishing System as specified in Section 44 31 17 and includes ancillary civil, structural and electrical work associated with its implementation.

Add \$_____

Alternate 2:

Alternate No. 2 generally consists of addition of Fiberglass Reinforced Plastic (FRP) Density Baffle Curtains as specified in Section 46 43 81, in each of six (6) existing secondary clarifiers.

Add

Description	Qty	Units	Unit Price	Extended
FRP Baffle Curtains	6	EA	\$	\$

Alternate 3:

Alternate No. 3 generally consists of addition of Energy Dissipating Feed wells as specified in Section 46 43 23 and includes the demolition of existing feed well and supports, as well as installation of new feed wells with supports and surface preparation and coating of new feed wells and supports. Add

Description	Qty	Units	Unit Price	Extended
Energy Dissipating Feed well	6	EA	\$	\$

Alternate 4:

Alternate No. 4 generally consists of Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System and includes ancillary civil, structural and electrical work associated with its implementation.

Add \$_____

Alternate 5:

Alternate No. 5 generally consists of Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building and includes ancillary civil, structural, mechanical and electrical work associated with its implementation.

Add \$_____

* All prices provided in the bid form represent a final contract price inclusive of any applicable taxes and freight

5. BIDDER agrees the Work will be substantially complete within **540** calendar days after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **560** calendar days after the date when the Contract Times commence to run. Prior to beginning construction, BIDDER shall submit a detailed schedule to OWNER and ENGINEER including, but not limited to, start/finish of cleaning by section, start/finish of lining by section, and start/finish of manhole repairs by section.

All railroad sites will require a delayed start until appropriate Permits are required. BIDDER shall acknowledge this and make accommodations within the detailed schedule submitted to OWNER and ENGINEER.

6. BIDDER accepts provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within times specified in the Agreement.
7. The following documents are attached to and made a condition of this Bid:
 - a. Required Bid Security in the form of 10 percent of the Bid Total Price.
 - b. A tabulation of Subcontractors, Suppliers and other persons and organizations required to be identified in this Bid.
 - c. Required BIDDER's Qualification Statement with supporting data.
8. The undersigned further agrees in case of failure on his/her part to execute the said contract and the Bond within 15 consecutive calendar days after written notice being given of the award of the contract, the check or bid bond accompanying this bid, and the monies payable thereon shall be paid into the funds of the Owner as liquidated damages for such failure, otherwise, the check or bid bond accompanying this proposal shall be returned to the undersigned.
9. Communications concerning this Bid shall be addressed to:

Pamela Crosby
 BGJWSC
 1703 Gloucester St.
 Brunswick, GA 31250
 pcrosby@bgjwsc.org

10. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions of Instructions.

SUBMITTED on _____, 2020.

CONTRACTOR'S NAME

ADDRESS:

BY: _____

State Contractor License No. _____ GA

DOCUMENT 00411

BID BOND

BIDDER (Name and Address):

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

OWNER (Name and Address):**Brunswick-Glynn County Joint Water and Sewer Commission****1703 Gloucester Street Brunswick, GA 31520****BID**

BID DUE DATE: _____ TUESDAY, SEPTEMBER 1, 2020 12:00 NOON EST

PROJECT (Brief Description Including Location):

The project includes the repair and upgrade of Academy Creek WPCF located at 2909 Newcastle Street Brunswick, GA 31520 The proposed construction consists of the rehabilitation of the screening structure, flow splitting modifications, RAS piping modifications, sludge pumping improvements, polymer system upgrades, tertiary filtration construction, polymer system upgrades, and additive alternates.

BONDBOND NUMBER: _____ DATE: _____
(Not later than Bid Due Date)PENAL SUM: _____
(5 % of Bid Sum)

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

BIDDER

_____(Seal)

Bidder's Name and Corporate Seal

By: _____

Signature and Title

Attest: _____

Signature and Title

SURETY

_____(Seal)

Surety's Name and Corporate Seal

By: _____

Signature and Title
(Attach Power of Attorney)

Attest: _____

Signature and Title

Note: (1) Above addresses are to be used for giving required notice.
(2) Any singular reference to Bidder, Surety, Owner, or other party shall be considered plural where applicable.

PENAL SUM FORM

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents and Contract Document, or
 - 3.2 All bids are rejected by Owner, or
 - 3.3 Owner fails to issue a notice of award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by bidder and, if applicable, consented to by Surety when required by paragraph 5 hereof.)
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of and any and all defenses based on arising out of any time extension to issue notice of award agreed to in writing by Owner and Bidder, provided that the time for issuing notice of award including extensions shall not in the aggregate exceed 120 days from Bid Due Date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety, and in no case later than one year after Bid Due Date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notice required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent or representative who executed this Bond on behalf of Surety to execute, seal and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of the Bond conflicts with any applicable provision of any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "bid" as used herein includes a bid, offer or proposal as applicable.

DOCUMENT 00506 STANDARD**FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR**

THIS AGREEMENT is dated as of the _____ day of _____ in the year 2020 by and between Brunswick-Glynn County Joint Water and Sewer Commission (BGJWSC) (hereinafter called OWNER) and _____ (hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 WORK

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

- a. The project includes the repair and upgrade of the Academy Creek WPCF located at 2909 Newcastle Street, Brunswick, GA 31520. The proposed construction consists of the Civil/site work and miscellaneous.
- b. Yard piping modifications
- c. Installation of new tertiary filtration
- d. Demolition and replacement of influent bar screens
- e. Installation of Biofilter Odor Treatment System
- f. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
- g. Construction of Main Flow Split Structure and attendant yard piping modifications.
- h. Gate replacement at three clarifier flow split structures
- i. Modification of RAS feed to each of three existing Aeration Basins
- j. Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers.(Additive Alternate No. 2)
- k. Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers.(Additive Alternate No. 3)
- l. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)
- m. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
- n. Modification of Belt Press feed piping.
- o. Miscellaneous valves and piping.
- p. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)
- q. Plant-wide fiber-optic network.
- r. Electrical work and controls.

ARTICLE 3 CONTRACT TIMES

3.2 *Liquidated Damages.* OWNER and CONTRACTOR recognize time is of the essence for this Agreement and OWNER will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by OWNER if the Work is not substantially complete on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree to liquidated damages for delay (but not as a penalty) the CONTRACTOR shall pay OWNER Two Thousand Five Hundred dollars (\$2,500.00) for each day expiring after the time specified in paragraph 3.1 for Substantial Completion until the Work is substantially complete. After Substantial completion, if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the time specified in paragraph 3.1 for completion and readiness for final payment or any proper extension thereof granted by OWNER, CONTRACTOR, shall pay One Thousand dollars (\$2,500.00) for each day expiring after the time specified in paragraph 3.1 for completion and readiness for final payment.

Z:\27784\27784.0000\Documents\Construction\Div. II\Division II (Pump Stations)\00506 - Standard Agreement.DOC

by ENGINEER as provided in paragraph 9.07 of the General Conditions. Unit prices have been computed as provided in paragraph 11.03C of the General Conditions.

ARTICLE 5 PAYMENT PROCEDURES

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

5.1 *Progress Payments; Retainage.* OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, on or about the **25th** day of each month during performance of the Work as provided in paragraphs 5.1.1., 5.1.1.2. and 5.2. below. All such payments will be measured by the schedule of values established in paragraph 2.07 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) as provided in the General Requirements.

5.1.1 *For Cost of Work:* Progress payments on account of the Cost of the Work will be made:

5.1.1.1 Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.02 of the General Conditions.

90% of the Work completed (with the balance being retainage). If Work has been 50% completed as determined by ENGINEER, and if the character and progress of the Work have been satisfactory to OWNER and ENGINEER, OWNER, on recommendation of ENGINEER, may determine as long as the character and progress of the Work remain satisfactory to them, there will be no additional retainage on account of Work completed, in which case the remaining progress payments prior to Substantial Completion will be in an amount equal to 100% of the Work completed.

90% of Cost of the Work (with the balance being retainage) applicable to materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in paragraph 14.02.A.1 of the General Conditions).

5.1.1.2 Upon Substantial Completion, in an amount sufficient to increase the total payments to CONTRACTOR to **95%** of the Cost of the Work, (with the balance being retainage), less such amounts as ENGINEER shall determine, or OWNER may withhold, in accordance with paragraph 14.02 of the General Conditions.

5.2 *Final Payment.* Upon final completion and acceptance of the Work in accordance with paragraph 14.07 of the General Conditions, OWNER shall pay

the remainder of the Contract Price as recommended by ENGINEER as provided in said paragraph 14.07.

ARTICLE 6 INTEREST

All moneys not paid within thirty (30) days of the due date as provided in Article 14 of the General Conditions, shall bear interest at the rate of 6 percent annually or the minimum required by law at the place of the Project, whichever is greater.

ARTICLE 7 CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement CONTRACTOR makes the following representations:

- 7.1 CONTRACTOR has examined and carefully studied the Contract Documents (including the Addenda indicated in Article 8 hereinafter) and the other related data identified in the Bidding Documents.
- 7.2 CONTRACTOR has visited the site and become familiar with and is satisfied as to the general, local and site conditions possibly affecting cost, progress, performance or furnishing of the Work.
- 7.3 CONTRACTOR is familiar with and is satisfied as to all federal, state, and local Laws and Regulations possibly affecting cost, progress, performance and furnishing of the Work.
- 7.4 CONTRACTOR has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in the General Conditions. CONTRACTOR acknowledges such reports and drawings are not Contract Documents and may not be complete for CONTRACTOR's purposes. CONTRACTOR acknowledges OWNER and ENGINEER do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to Underground Facilities at or contiguous to the site. CONTRACTOR has obtained and carefully studied (or assumes responsibility for having done so) all such additional supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the construction to be employed by CONTRACTOR and safety precautions and programs incident thereto. CONTRACTOR does not consider any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents.
- 7.5 CONTRACTOR is aware of the general nature of work to be performed by OWNER and others at the site relating to the Work as indicated in the Contract Documents.

- 7.6 CONTRACTOR has correlated the information known to CONTRACTOR, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- 7.7 CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities or discrepancies CONTRACTOR has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 8 CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

- 8.1 Invitation to Bid (Pages 00021-1 to 00021-1, inclusive)
- 8.2 Instructions to Bidders (pages 00110-1 to 00110-7, inclusive)
- 8.3 Bid Form (pages 00313-1 to 00313-8, inclusive)
- 8.4 Bid Bond (pages 00411-1 to 00411-2, inclusive)
- 8.5 Standard Form of Agreement Between Owner and Contractor (pages 00506-1 to 00506-7, inclusive)
- 8.6 Performance Bond (pages 00611-1 to 00611-6, Inclusive)
- 8.7 Payment Bond (pages 00621-1 to 00621-6, inclusive)
- 8.8 Notice of Award (pages 00631-1 to 00631-3, inclusive)
- 8.9 Notice to Proceed (pages 00641-1 to 00641-2, inclusive)
- 8.10 General Conditions (pages 001700 1 to 62, inclusive)
- 8.11 Special Conditions (pages 00710-1 to 00710-6, inclusive)
- 8.12 Supplementary Conditions (pages 00815-1 to 00815-5, inclusive)
- 8.13 Summary of Work (pages 01011-1 to 01011-2, inclusive)
- 8.14 Measurement and Payment (pages 01025-1 to 01025-2, inclusive)
- 8.15 Submittals (pages 01300-1 to 01300-14, inclusive)
- 8.16 Quality Control (pages 01400-1 to 01400-3, inclusive)

- 8.17 Testing Services (pages 01410-1 to 01410-6, inclusive)
- 8.18 Contract Closeout (pages 01702-1 to 01702-4, inclusive)
- 8.19 Operations and Maintenance (pages 01730-1 to 1730-4, inclusive)
- 8.20 Warranties (pages 01740-1 to 01740-2, inclusive)
- 8.21 Bonds (pages 01741-1 to 1741-2, inclusive)
- 8.22 Technical Specifications are as listed in the Table of Contents.
- 8.23 Drawings consisting of sheets CO through M1.1 with each sheet bearing the following general title:
 - a. CONTRACTOR's Bid (page_____through page_____inclusive) marked "Exhibit_____."
 - b. Documentation submitted by CONTRACTOR prior to Notice of Award (pages____to____, inclusive).
 - c. Any modification, including Change Orders, duly delivered after execution of Agreement.

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraph 3.04 of the General Conditions.

ARTICLE 9 MISCELLANEOUS

- 9.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.
- 9.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys becoming due and moneys due, may not be assigned without such consent (except to the extent the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 9.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.
- 9.4 Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and CONTRACTOR, who agree the Contract Documents shall be reformed to replace such stricken

provision or part thereof with a valid and enforceable provision coming as close as possible to expressing the intention of the stricken provision.

ARTICLE 10 OTHER PROVISIONS

10.1 Specific areas, of the Work, as outlined in Article 1 of this Contract, must be completed at night. Prior to construction a Pre-Construction meeting will be required between the OWNER, CONTRACTOR, and ENGINEER to determine areas of work that shall be completed at night. Any other outstanding concerns shall be addressed at this meeting.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in five counterparts. Two counterparts each have been delivered to OWNER and CONTRACTOR and one counterpart to ENGINEER. All portions of the Contract Documents have been signed, initialed or identified by Owner and Contractor or identified by ENGINEER on their behalf.

This Agreement will be effective on _____, 2020 (which is the Effective Date of the Agreement).

OWNER Brunswick-Glynn County Joint Water and Sewer Commission (BGJWSC) CONTRACTOR _____

BY (typed) _____ BY (typed) _____

BY _____ BY _____

ATTEST _____ ATTEST _____

Address for giving notices

Address for giving notices

1703 Gloucester Street Brunswick, GA 31520

License No. _____

Agent for service of process: _____

CORPORATE SEAL

CORPORATE SEAL

DOCUMENT 00611**PERFORMANCE BOND**

KNOW ALL MEN BY THESE PRESENTS, _____,
(Name & Address of Contractor)

hereinafter called "Principal" and _____,
(Name & Address of Surety)

_____ of _____

State of _____, hereinafter called the "Surety" are held and

firmly bound unto _____

hereinafter called the "Owner" in the penal sum of _____

_____ Dollars (\$_____))
(Contract Sum)

lawful money of the United States of America, to be paid to OWNER, for the payment whereof well and truly to be made we do bind ourselves, our respective executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bounden Principal has entered into a certain contract with the Owner dated the _____ day of _____, 20____ for the construction of:

_____ 2019 WPCF Rehabilitation Academy Creek _____
(Name of Contract/Project)

which said contract is incorporated hereby by reference and made a part hereof and is hereinafter referred to as the Construction Contract.

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such, if the Principal shall promptly and faithfully perform and comply with the terms and conditions of said contract; and shall indemnify and save harmless the Owner against and from all costs, expenses, damages, injury or loss to which said Owner may be subjected by reason of any wrongdoing, including patent infringement, misconduct, want of care or skill, default, or failure of performance on the part of said Principal, its agents, subcontractors or employees, in the execution or performance of said Construction Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

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

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.
3. If there is no Owner Default, the Surety's obligations under this Bond shall arise after:
 - 3.1 The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below, the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and
 - 3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and
 - 3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a Contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.
4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense, take one of the following actions:
 - 4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or
 - 4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent Contractors; or
 - 4.3 Obtain bids or negotiated proposals from qualified Contractors acceptable to the Owner in a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the Contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or
 - 4.4 Waive its right to perform and complete, arrange for completion, or obtain a new Contractor and with reasonable promptness under the circumstances;

- 4.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefor to the Owner; or
 - 4.4.2 Deny liability in whole or in part and notify the Owner citing reasons therefor.
- 5. If the Surety does not proceed as provided in paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.
- 6. After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:
 - 6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract:
 - 6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and
 - 6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
- 7. The Surety shall not be liable to the Owner or others for obligations of the Contractor unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, or successors.
- 8. The Surety hereby waives notice of any changes, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.
- 9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum

period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.
11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is this Bond shall be construed as a statutory bond and not as a common law bond.
12. DEFINITIONS:
 - 12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto;
 - 12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.
 - 12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

IN WITNESS WHEREOF, this instrument is executed in six counterparts, each one of which shall be deemed an original, on this the _____ day of _____, 2020.

CONTRACTOR AS PRINCIPAL:

Principal

(Principal) Secretary

By: _____
(Signature & Title)

(SEAL)

Address

Witness as to Principal

Address

SURETY:

Surety (Company)

(Surety) Secretary

By: _____
Attorney-in-Fact

(SEAL)

Witness as to Surety

Address

Notes:

1. Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute bond.
2. Bond must be countersigned by a Georgia resident agent.
3. Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

DOCUMENT 00621**PAYMENT BOND**

KNOW ALL MEN BY THESE PRESENTS, _____,
(Name & Address of Contractor)

hereinafter called "Principal" and _____,
(Name & Address of Surety)

_____ of _____

State of _____, hereinafter called the "Surety" are held and

firmly bound unto _____

hereinafter called the "Owner" in the penal sum of _____

_____ Dollars (\$_____))
(Contract Sum)

lawful money of the United States of America, to be paid to OWNER, for the payment whereof well and truly to be made we do bind ourselves, our respective executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the above bounden Principal has entered into a certain contract with the Owner dated the _____ day of _____, 20____ for the construction of:

2019 WPCF REHABILITATION ACADEMY CREEK
(Name of Contract/Project)

which said contract is incorporated hereby by reference and made a part hereof and is hereinafter referred to as the Construction Contract.

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such, if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and materials supplied in the prosecution of the work provided for in said Construction Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. With respect to the Owner, this obligation shall be null and void if the Contractor:
 - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants; and

- 2.2 Defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity whose claim, demand, lien or suit is for payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.
4. The Surety shall have no obligation to Claimants under this Bond until:
 - 4.1 Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating a claim is being made under this Bond and, with substantial accuracy, the amount of claim.
 - 4.2 Claimants who do not have a direct contract with the Contractor:
 - 4.2.1 Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was performed; and
 - 4.2.2 Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice, any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and
 - 4.2.3 Not having been paid within 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.
5. Compliance shall be considered sufficient if a notice required by paragraph 4 is given by the Owner to the Contractor or to the Surety.
6. When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:
 - 6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim stating the amounts undisputed and basis for challenging any amounts disputed.

6.2 Pay or arrange for payment of any undisputed amounts.

7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
8. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and the Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
9. The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.
11. No suit or action shall be commenced by a Claimant under this bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4.1 or Clause 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to Sureties as a defense in the jurisdiction of the suit shall be applicable.
12. Notice to the Surety, Owner or Contractor shall be mailed or delivered to the address shown on the signature page. Actual receipt of notice by the Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in the Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is this Bond shall be construed as a statutory bond and not as a common law bond.
14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.
15. DEFINITIONS:

- 15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, material, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment," that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.
- 15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.
- 15.3 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

IN WITNESS WHEREOF, this instrument is executed in six counterparts, each one of which shall be deemed an original, on this the _____ day of _____, 2020.

CONTRACTOR AS PRINCIPAL:

Principal

(Principal) Secretary

By: _____
(Signature & Title)

(SEAL)

Address

Witness as to Principal

Address

SURETY:

Surety (Company)

(Surety) Secretary

By: _____
Attorney-in-Fact

(SEAL)

Witness as to Surety

Address

Notes:

1. Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute bond.
2. Bond must be countersigned by a Georgia resident agent.
3. Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

SECTION 00631
NOTICE OF AWARD

Dated _____

TO: _____
(Bidder)

ADDRESS: _____

JOB NO.: _____

PROJECT: 2019 WPCF Rehabilitation Academy Creek

CONTRACT FOR:

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

- a. The project includes the repair and upgrade of the Academy Creek WPCF located at 2909 Newcastle Street, Brunswick, GA 31520. The proposed construction consists of the Civil/site work and miscellaneous.
- b. Yard piping modifications
- c. Installation of new tertiary filtration
- d. Demolition and replacement of influent bar screens
- e. Installation of Biofilter Odor Treatment System
- f. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
- g. Construction of Main Flow Split Structure and attendant yard piping modifications.
- h. Gate replacement at three clarifier flow split structures
- i. Modification of RAS feed to each of three existing Aeration Basins
- j. Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers.(Additive Alternate No. 2)
- k. Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers.(Additive Alternate No. 3)
- l. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)
- m. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
- n. Modification of Belt Press feed piping.
- o. Miscellaneous valves and piping.
- p. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)

- q. Plant-wide fiber-optic network.
- r. Electrical work and controls.

You are notified your Bid dated _____, 2020, for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for:

2019 WPCF Rehabilitation Academy Creek
(Indicate total Work, alternates or sections of Work awarded)

The Contract Price of your contract is _____

_____ Dollars (\$_____).

5 copies of each of the proposed Contract Documents (except drawings) accompany this Notice of Award.

5 sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within 15 days of this Notice of Award, which is by _____, 2020.

1. You must deliver to the OWNER six (6) fully executed counterparts of the Agreement including all the Contract Documents. Each of the Contract Documents must bear your signature on the page.
2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Instructions to Bidders (Article 8), General Conditions (paragraph 5.01) and Supplementary Conditions.
3. (List other conditions precedent)

Failure to comply with these conditions within the time specified will entitle OWNER to consider your bid in default, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten days after you comply with the above conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

BRUNSWICK-GLYNN COUNTY JOINT WATER
AND SEWER COMMISSION
OWNER

By: _____

(Title)

ACCEPTANCE OF AWARD

(Contractor)

By: _____
(Authorized Signature)

(Title)

(Date)

Section 00641**NOTICE TO PROCEED**

Dated: _____

TO: _____
(Bidder)ADDRESS: _____

JOB NO.: 906

PROJECT: 2019 WPCF Rehabilitation Academy Creek**CONTRACT:**

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

- a. The project includes the repair and upgrade of the Academy Creek WPCF located at 2909 Newcastle Street, Brunswick, GA 31520. The proposed construction consists of the Civil/site work and miscellaneous.
- b. Yard piping modifications
- c. Installation of new tertiary filtration
- d. Demolition and replacement of influent bar screens
- e. Installation of Biofilter Odor Treatment System
- f. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
- g. Construction of Main Flow Split Structure and attendant yard piping modifications.
- h. Gate replacement at three clarifier flow split structures
- i. Modification of RAS feed to each of three existing Aeration Basins
- j. Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers.(Additive Alternate No. 2)
- k. Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers.(Additive Alternate No. 3)
- l. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)
- m. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
- n. Modification of Belt Press feed piping.
- o. Miscellaneous valves and piping.
- p. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)
- q. Plant-wide fiber-optic network.
- r. Electrical work and controls.

You are notified the Contract Times under the above contract will commence to run on

_____, 20 . By such date, you are to start performing your obligations under the Contract Documents. In accordance with Article 3 of the Agreement the dates of Substantial Completion and completion and readiness for final payment are _____, 20 and _____, 20 , respectively.

Before you may start any Work at the site, paragraph 2.01 of the General Conditions provides you and OWNER must each deliver to the other (with copies to ENGINEER and other identified additional insureds) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents.

Before you may start any Work at the site, you must have submitted the following: Certificate of Insurance, Performance Bond, and Payment Bond.

BRUNSWICK-GLYNN COUNTY JOINT WATER AND SEWER
COMMISSION

OWNER

By: _____

(Title)

ACCEPTANCE OF NOTICE TO PROCEED

(Contractor)

By: _____
(Authorized Signature)

(Title)

(Date)

**Engineers Joint Documents Committee
Design and Construction Related Documents
Instructions and License Agreement**

Instructions

Before you use any EJCDC document:

1. Read the License Agreement. You agree to it and are bound by its terms when you use the EJCDC document.
2. Make sure that you have the correct version for your word processing software.

How to Use:

1. While EJCDC has expended considerable effort to make the software translations exact, it can be that a few document controls (e.g., bold, underline) did not carry over.
2. Similarly, your software may change the font specification if the font is not available in your system. It will choose a font that is close in appearance. In this event, the pagination may not match the control set.
3. If you modify the document, you must follow the instructions in the License Agreement about notification.
4. Also note the instruction in the License Agreement about the EJCDC copyright.

License Agreement

You should carefully read the following terms and conditions before using this document. Commencement of use of this document indicates your acceptance of these terms and conditions. If you do not agree to them, you should promptly return the materials to the vendor, and your money will be refunded.

The Engineers Joint Contract Documents Committee ("EJCDC") provides **EJCDC Design and Construction Related Documents** and licenses their use worldwide. You assume sole responsibility for the selection of specific documents or portions thereof to achieve your intended results, and for the installation, use, and results obtained from **EJCDC Design and Construction Related Documents**.

You acknowledge that you understand that the text of the contract documents of **EJCDC Design and Construction Related Documents** has important legal consequences and that consultation with an attorney is recommended with respect to use or modification of the text. You further acknowledge that EJCDC documents are protected by the copyright laws of the United States.

License:

You have a limited nonexclusive license to:

1. Use **EJCDC Design and Construction Related Documents** on any number of machines owned, leased or rented by your company or organization.
2. Use **EJCDC Design and Construction Related Documents** in printed form for bona fide contract documents.
3. Copy **EJCDC Design and Construction Related Documents** into any machine readable or printed form for backup or modification purposes in support of your use of **EJCDC Design and Construction Related Documents**.

You agree that you will:

1. Reproduce and include EJCDC's copyright notice on any printed or machine-readable copy, modification, or portion merged into another document or program. All proprietary rights in **EJCDC Design and Construction Related Documents** are and shall remain the property of EJCDC.
2. Not represent that any of the contract documents you generate from **EJCDC Design and Construction Related Documents** are EJCDC documents unless (i) the document text is used without alteration or (ii) all additions and changes to, and deletions from, the text are clearly shown.

You may not use, copy, modify, or transfer EJCDC Design and Construction Related Documents, or any copy, modification or merged portion, in whole or in part, except as expressly provided for in this license. Reproduction of EJCDC Design and Construction Related Documents in printed or machine-readable format for resale or educational purposes is expressly prohibited.

If you transfer possession of any copy, modification or merged portion of EJCDC Design and Construction Related Documents to another party, your license is automatically terminated.

Term:

The license is effective until terminated. You may terminate it at any time by destroying **EJCDC Design and Construction Related Documents** altogether with all copies, modifications and merged portions in any form. It will also terminate upon conditions set forth elsewhere in this Agreement or if you fail to comply with any term or condition of this Agreement. You agree upon such termination to destroy **EJCDC Design and Construction Related Documents** along with all copies, modifications and merged portions in any form.

Limited Warranty:

EJCDC warrants the CDs and diskettes on which **EJCDC Design and Construction Related Documents** is furnished to be free from defects in materials and workmanship under normal use for a period of ninety (90) days from the date of delivery to you as evidenced by a copy of your receipt.

There is no other warranty of any kind, either expressed or implied, including, but not limited to the implied warranties of merchantability and fitness for a particular purpose. Some states do not allow the exclusion of implied warranties, so the above exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

EJCDC does not warrant that the functions contained in **EJCDC Design and Construction Related Documents** will meet your requirements or that the operation of **EJCDC Design and Construction Related Documents** will be uninterrupted or error free.

Limitations of Remedies:

EJCDC's entire liability and your exclusive remedy shall be:

1. the replacement of any document not meeting EJCDC's "Limited Warranty" which is returned to EJCDC's selling agent with a copy of your receipt, or
2. if EJCDC's selling agent is unable to deliver a replacement CD or diskette which is free of defects in materials and workmanship, you may terminate this Agreement by returning EJCDC Document and your money will be refunded.

In no event will EJCDC be liable to you for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use or inability to use **EJCDC Design and Construction Related Documents** even if EJCDC has been advised of the possibility of such damages, or for any claim by any other party.

Some states do not allow the limitation or exclusion of liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you.

General:

You may not sublicense, assign, or transfer this license except as expressly provided in this Agreement. Any attempt otherwise to sublicense, assign, or transfer any of the rights, duties, or obligations hereunder is void.

This Agreement shall be governed by the laws of the State of Virginia. Should you have any questions concerning this Agreement, you may contact EJCDC by writing to:

Arthur Schwartz, Esq.
General Counsel

National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314

Phone: (703) 684-2845
Fax: (703) 836-4875
e-mail: aschwartz@nspe.org

You acknowledge that you have read this agreement, understand it and agree to be bound by its terms and conditions. You further agree that it is the complete and exclusive statement of the agreement between us which supersedes any proposal or prior agreement, oral or written, and any other communications between us relating to the subject matter of this agreement.

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by



AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE

A Practice Division of the

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

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

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(703) 684-2882
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Associated General Contractors of America
2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
(703) 548-3118
www.agc.org

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.1 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.2 Terminology

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

B. *Intent of Certain Terms or Adjectives:*

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

C. *Day:*

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

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

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

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.1 *Delivery of Bonds and Evidence of Insurance*

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

2.2 *Copies of Documents*

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

2.3 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.4 *Starting the Work*

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

2.5 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.6 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.7 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on

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

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.1 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.2 *Reference Standards*

- A. Standards, Specifications, Codes, Laws, and Regulations
 1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.3 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:
 - a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.4 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;
2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
3. Engineer's written interpretation or clarification.

3.5 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

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

3.6 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.1 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.2 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.3 *Differing Subsurface or Physical Conditions*

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

1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
2. is of such a nature as to require a change in the Contract Documents; or
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

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

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

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

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

- c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.4 *Underground Facilities*

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

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

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

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

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

4.5 *Reference Points*

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

4.6 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.1 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.2 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also

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

5.3 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.4 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

- a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
 2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
 3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
 4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
 5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
 6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.5 *Owner's Liability Insurance*

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

5.6 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
 - 2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
 - 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 - 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 - 5. allow for partial utilization of the Work by Owner;
 - 6. include testing and startup; and
 - 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

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

- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.7 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.8 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

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

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

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

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.1 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.2 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.3 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.4 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.5 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
 - 1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

- c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
 - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.
- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.6 Concerning Subcontractors, Suppliers, and Others

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be

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

- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,

Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.7 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.8 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.9 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

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

- 1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
- 2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
- 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought

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

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

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

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and

shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is

required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

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

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

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

C. *Submittal Procedures:*

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

- a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
- b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
- c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
- d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. Engineer's Review:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures:

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

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 - 1. observations by Engineer;
 - 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. use or occupancy of the Work or any part thereof by Owner;
 - 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
 - 6. any inspection, test, or approval by others; or
 - 7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

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

ARTICLE 7 – OTHER WORK AT THE SITE

7.1 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
1. written notice thereof will be given to Contractor prior to starting any such other work; and
 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.2 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 3. the extent of such authority and responsibilities will be provided.

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

7.3 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.1 *Communications to Contractor*

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

8.2 *Replacement of Engineer*

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

8.3 *Furnish Data*

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

8.4 *Pay When Due*

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

8.5 *Lands and Easements; Reports and Tests*

- A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.6 *Insurance*

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

8.7 *Change Orders*

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

8.8 *Inspections, Tests, and Approvals*

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

8.9 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

8.12 *Compliance with Safety Program*

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

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.1 *Owner's Representative*

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

9.2 *Visits to Site*

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

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

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

9.3 *Project Representative*

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

9.4 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.5 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.6 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.7 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

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

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.9 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise

or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

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

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.1 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.2 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.3 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
 - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.4 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.5 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data

shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
 2. approve the Claim; or
 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

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

11.1 *Cost of the Work*

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of

said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

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

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not

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

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.
- C. *Contractor's Fee*: When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.
- D. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.2 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*:
 1. Contractor agrees that:
 - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*:
 1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.3 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to

the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

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

12.1 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

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

1. a mutually acceptable fixed fee; or
2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.2 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.3 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or

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

- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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

13.1 *Notice of Defects*

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

13.2 *Access to Work*

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

13.3 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.4 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.5 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.6 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.7 *Correction Period*

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

1. repair such defective land or areas; or
 2. correct such defective Work; or
 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.8 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.9 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.1 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.2 *Progress Payments*

A. *Applications for Payments:*

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

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

- involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
- b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. Reduction in Payment:

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.3 Contractor's Warranty of Title

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.4 Substantial Completion

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before

final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.5 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
 - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.6 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.7 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and
 - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying

documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due:

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.8 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.9 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
 1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.1 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.2 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 - 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 - 3. Contractor's repeated disregard of the authority of Engineer; or
 - 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
 - 1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
 - 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 - 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when

so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.3 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 - 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.4 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days

to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.1 *Methods and Procedures*

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
 - 1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agrees with the other party to submit the Claim to another dispute resolution process; or
 - 3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.1 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.2 *Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.3 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.4 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.5 *Controlling Law*

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

17.6 *Headings*

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

DOCUMENT 00710**SPECIAL CONDITIONS**

SC-1 DESCRIPTION OF THE WORK The project includes the repair and upgrade the Academy Creek WPCF located at 2909 Newcastle Street, Brunswick, GA 31520. Work shall include all labor, equipment, materials, appurtenances and incidentals required to complete this project:

- a. Civil/site work and miscellaneous.
- b. Yard piping modifications
- c. Installation of new tertiary filtration
- d. Demolition and replacement of influent bar screens
- e. Installation of Biofilter Odor Treatment System
- f. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
- g. Construction of Main Flow Split Structure and attendant yard piping modifications.
- h. Gate replacement at three clarifier flow split structures
- i. Modification of RAS feed to each of three existing Aeration Basins
- j. Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers.(Additive Alternate No. 2)
- k. Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers.(Additive Alternate No. 3)
- l. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)
- m. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
- n. Modification of Belt Press feed piping.
- o. Miscellaneous valves and piping.
- p. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)
- q. Plant-wide fiber-optic network.
- r. Electrical work and controls.

SC-2 COMMENCEMENT AND COMPLETION OF WORK: The Contractor shall commence work within 10 days after Notice to Proceed is issued. Work shall be completed within **540** calendar days.

If the Contractor fails to prosecute the work with such diligence as will insure the completion of each portion of the work within the time shown on the above schedule, plus any extensions made in accordance with Article 12 of the General Conditions; and, if the Owner does not exercise reservations as set forth in Article 13 of the General Conditions, the Contractor shall continue the work in which event liquidated damages for the delay will be impossible to determine. In lieu thereof, liquidated damages in the amount of \$1,000.00 per each day of delay of the work until the work is completed.

SC-3 DRAWINGS: The work shall conform to the process drawings, all of which form a part of, and are included in, these specifications and are available in the office of Goodwyn Mills & Cawood, 7 East Congress Street Suite 504 Savannah, Georgia 31401.

SC-4 LAYOUT OF WORK: Control lines and master benchmarks will be furnished by the Owner. The Contractor will lay out work and will be responsible for all measurements in connection therewith.

SC-5 OBSERVATIONS AND TESTS: Before acceptance of the whole or any part of the work, it shall be subjected to observation and tests to determine it is in accordance with the plans and specifications. The Contractor will be required to maintain all work in a first- class condition for a 30-day operating period after the same has been completed as a whole and the Engineer has notified the Contractor in writing the work has been finished. The Contractor shall pay for all testing and shall engage a mutually acceptable laboratory or qualified individual to conduct the tests in accordance with these specifications. No portion of the work will be accepted until tests prove it has been satisfactorily completed. The Contractor shall give the Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

SC-6 BONDS: The Performance Bonds in the amount of 100% of the contract amount and Payment Bonds in the amount of 100% of the contract amounts shall be furnished in accordance with Article 5 of the General Conditions.

SC-7 CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE: The Contractor shall not commence work under this contract until obtaining all the insurance required under this paragraph and such insurance has been accepted by the Owner, nor shall the Contractor allow any Subcontractor to commence work on a subcontract until the insurance required of the Subcontractor has been so obtained and accepted.

- a. Compensation and Employer's Liability Insurance: The Contractor shall take out and maintain during the life of the contract the statutory Worker's Compensation and Employer's Liability Insurance for all of its employees to be engaged in work on the project under the contract and, in case and such work is sublet, the Contractor should require the Subcontractor similarly to provide Worker's Compensation and Employer's Liability Insurance for all the latter's employees to be engaged in such work.
- b. Bodily Injury Liability and Property Damage Liability Insurance: The Contractor shall take out and maintain during the life of the contract Bodily Injury Liability and Property Damage Liability Insurance to protect itself and any Subcontractor performing work covered by the contract from claims for damages or personal injury, including accidental death, as well as from claims for property damage, which may arise from operations under the contract, whether such operations be by the Contractor, Subcontractor, or anyone directly or indirectly employed by either of them and the amount of such insurance should be not less than:
 - (1) Bodily Injury Liability Insurance, in an amount not less than \$1,000,000.00 for injuries, including wrongful death to any one person and subject to the same limit for each person in an amount not less than \$2,000,000.00 on account of one accident. Contractual liability should be endorsed on the policy.

- (2) Property Damage Insurance in an amount not less than \$1,000,000.00 for damages on account of any one accident, and in an amount not less than \$2,000,000.00 for damages on account of all accidents.

- c. Builder's Risk Insurance (Fire and Extended Coverage): The Contractor shall have adequate fire and standard extended coverage, with a company or companies acceptable to the Owner, in force on the project.

The provisions with respect to Builder's Risk Insurance shall in no way relieve the Contractor of its obligation of completing the work covered by the Contract.

- d. Proof of Carriage of Insurance: The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations, effective dates, and date of expiration of policies. Such certificates shall contain substantially the following statement: "The insurance covered by this certification shall not be cancelled or materially altered, except after ten (10) days written notice has been received by the Owner."

SC-8 HOLD HARMLESS CLAUSE: The Contractor agrees to hold harmless, indemnify and defend the Owner and its agents, architects, engineers and employees from and against any and all claims, losses, damages, demands, causes of action and any and all related costs and expenses, of every kind and character, growing out of, incidental to, or resulting directly or indirectly from the Contractor's performance of the work described herein, whether such loss, damage, injury, or liability is contributed to by the negligence of the Owner, its agents, architects, engineers, or employees, except the Contractor shall have no liability for damages or the costs incidental thereto caused by the sole negligence of the Owner, its agents, architects, engineers, or employees. The Contractor will require any and all subcontractors to conform with the provisions of this clause prior to commencing any work and agrees to ensure this clause is in conformity with the insurance provisions of the contract.

SC-9 CONTRACTOR'S STATUS: It is agreed the Contractor shall occupy the status of an Independent Contractor and the Contractor's employees are not employees of the Owner.

SC-10 CONTRACTOR'S AFFIDAVIT: Upon completion of the work and prior to final payment and settlement of all sums due hereunder, Contractor will furnish to Owner a Contractor's Affidavit in the usual form submitted by Contractor under the laws of the State of Georgia to the effect all bills for labor, materials and services in connection with said contract have been paid in full, acknowledging receipt of the contract price and averring there are no outstanding claims under said contract which could become a lien on the real estate arising out of said contract.

SC-11 RESIDENT PROJECT ENGINEER: The Owner reserves the right to furnish a Resident Project Engineer as deemed necessary to insure the Project quality control and conformance to Plans and Specifications, who will act as the Owner's Representative on the Project and will have the authority of the Engineer as set forth in the Contract Documents.

SC-12 BARRICADES, DANGER AND WARNING SIGNS: The Contractor shall install and maintain barricades, suitable and sufficient lights, danger signals, signs, and other traffic control devices and shall take all necessary precautions for the protection of the work and safety of the public. Lanes closed to traffic shall be protected by effective barricades, lighted during hours of darkness. Suitable warning signs shall be provided to control, direct traffic, and warn pedestrians. Upon completion all barricades, signs and the like shall be removed.

SC-13 TOOLS, PLANT AND EQUIPMENT: If at any time before the commencement or during the progress of the work, tools, plant or equipment appear to the Engineer to be insufficient, inefficient or inappropriate to secure the quality of the work required or the proper rate of progress, the Engineer may order the Contractor to increase their efficiency, to improve their character, to augment their number, or to substitute new tools, plant, or equipment, as the case may be, and the Contractor must conform to such order; but a failure of the Engineer to demand such increase of efficiency, number, or improvement shall not relieve the Contractor of its obligation to secure the quality of work and the rate of progress necessary to complete the work within the time required by the contract to the satisfaction of the Owner.

SC-14 ACCIDENTS: The Contractor shall provide, at the site, such equipment and medical facilities as are necessary to supply first-aid service to anyone who may be injured in connection with the work. The Contractor must report in writing to the Engineer all accidents whatsoever arising out of, or in connection with, the performance of the work, whether on or adjacent to the site, which causes death, personal injury or property damages, giving full details and statement of witnesses. In addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the Contractor and any subcontractor on account of any accident, the Contractor shall promptly report the facts to the Engineer, giving full details in writing of the claim. The Contractor shall advise its superintendent and foreman, who are on the site of the work, the name of the hospital and phone number and the name and phone number of the doctor to use in case of an accident.

SC-15 SANITARY PROVISIONS: The Contractor shall provide temporary sanitary facilities for the use of the workmen during the progress of the work. The sanitary facilities shall conform to the requirements of the Department of Public Health. All facilities shall be removed at the completion of the contract.

SC-16 MODIFICATION OF QUANTITIES: The itemized quantities shall be considered by the Contractor as the quantities required to complete the work for the purpose of bidding. Should actual quantities required in the construction of the work be greater or less than the quantities shown on the items, an amount equal to the difference in quantities at the unit prices for the item will be added to or deducted from the contract price.

When itemized quantities are not given in the Proposal, the work shown on the plans or specified shall be considered by the Contractor to be included in the contract for the lump sum prices bid.

SC-17 RESPONSIBILITY REGARDING EXISTING UTILITIES AND STRUCTURES: The existence and location of underground utilities will be investigated and verified in the field by the Contractor before starting work. The Contractor shall call for underground utility locations. Underground utilities location service can be contacted at 1-800-282-7411 (GA). The location of all known interferences based on the best information available

has been shown on the drawings, but this information may not be complete. Excavation in the vicinity of existing structures and utilities shall be carefully done by hand. The Contractor shall be held responsible for any damage to and for maintenance and protection of existing utilities and structures. The Contractor is responsible for coordinating with the utility companies any relocation, adjustment, or replacement of utility facilities.

SC-18 INTERRUPTION OF UTILITY SERVICE: The Contractor's operations shall be conducted to interfere as little as possible with utility services. Any proposed interruption by the Contractor must be accepted in advance by the Engineer.

SC-19 OMISSION: The drawings and specifications shall both be considered as a part of the contract. Any work and material shown in the one and omitted in the other, or described in the one and not shown in the other, or which may fairly be implied by both or either, shall be furnished and performed as though shown in both, in order to give a complete and first class job.

SC-20 MEASUREMENT AND PAYMENT: Measurement and payment shall be made for the units and at the lump sum contract prices shown on the Bid Schedule. Direct payment shall only be made for those items or work specifically listed in the proposal and the cost of any other work must be included in the contract price for the applicable items to which it relates.

SC-21 "OR EQUIVALENT," CLAUSE: Although the plans and specifications make reference to particular manufacturers and model numbers for various products, such reference is made only to establish function and quality of such products. If it is desired to use materials or equipment of trade names or of manufacturer's names that are different from those mentioned in the contract documents, information pertaining to such items must reach the hands of the Engineer at least 10 days prior to the date set for the opening of bids. The burden of proving equality of a proposed substitute to an item designated by trade name or by manufacturer's name in the contract document rests on the party submitting the request for acceptance. The written application for review of a proposed substitute must be accompanied by technical data that the party requesting review desires to submit in support of its application. The Engineer will give consideration to reports from reputable independent testing laboratories, verified experience records showing the reputation of the proposed product with previous users or any other written information that is reasonable in the circumstances. The application to the Engineer for review of a proposed substitute must be accompanied by a schedule setting forth in what respects the material or equipment submitted for consideration differs from the materials or equipment designated in the contract documents. The degree of proof required for acceptance of a proposed substitute as equivalent to a named product is the amount of proof necessary to convince the Engineer beyond all doubt. To be acceptable, a proposed substitute must, in addition, meet or exceed all express requirements of the contract documents.

If submittal is accepted by the Engineer, an addendum will be issued to all prospective bidders at least five days prior to the date set for the opening of bids.

The Engineer shall be the final judge on questions of similarity and equality.

SC-22 SAFETY AND HEALTH REGULATIONS: The Contractor shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the

Occupational Safety and Health Act of 1970 as amended through January 1, 2004 (PL 91-596) and under Section 107 of the Contract Work and Safety Standards Act (PL 91-54). The regulations are administered by the Department of Labor and the Contractor shall allow access to the project to personnel from that Department.

SC-23 RECORD DATA AND DRAWINGS: The Contractor shall keep accurate, legible records of the locations, types, and sizes of sanitary lines, service laterals, manholes, cleanouts, water lines, fittings, valves, hydrants, drainage pipes, drainage structures, and other related work performed under this project. Where proposed and existing utilities cross, the Contractor shall measure and record the horizontal location and vertical separation between each crossing. Separation shall be measured between exteriors of pipes. On a set of project prints provided by the Owner, the Contractor shall prepare a set of "record" drawings from the data stated above. The horizontal locations of all portions of items installed on this project shall be accurately tied down to features that are physical and visible, such as property corner markers and/or permanent type structures. Invert elevations of all manholes, storm sewers and structures, sanitary sewers and lift stations shall be clearly indicated. These "record" drawings shall be kept clean and dry and maintained in a current state with the progress of the work. If at any time, a copy of this plan or portion of it is requested by the Owner, such copy shall be made available within 24 hours after the request is made.

Before final acceptance of the completed installation and final payment by the Owner, the Contractor shall deliver to the Engineer, four sets of "Record" Drawings accurately depicting the horizontal and vertical as-built data described in the above paragraph. "Record" drawings for the items installed on this project shall be certified by a licensed surveyor registered in Georgia. The size of the drawings shall be 24" x 36". The "Record" drawings shall have a coordinate system based on the Georgia State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD83). Elevations shall be based on the North American Vertical Datum of 1988 (NAVD 88). All measurements and coordinates shown shall use the U.S. Survey flood definition. Coordinates shall be shown on all drainage structures, sanitary sewer manholes, storm manholes/boxes, valve boxes/vaults, valve manholes, valves, fire hydrants, fittings, and all other related work performed under this contract. Vertical data including but not limited to, structure and manhole frame and inverts, pipe inverts, lift station frame, inverts, control levels, bottom, site grading, and as-built grading shall be shown. In addition to the "Record" drawings, Contractor shall deliver to Engineer electronic AutoCAD (v. 14 or later) files of all the data described above on a CD-ROM.

SC-24 PROPERTY CORNERS: The Contractor shall be responsible for restoring any property corners or monuments disturbed during construction. They shall be restored by a professional surveyor registered in the State of Georgia.

SC-25 VIDEO: A video showing existing site conditions shall be made by the Contractor prior to start of construction. Contractor shall provide Owner and Engineer a copy of the video. Contractor is encouraged to record any existing damaged facilities that could be questioned later by property owners. A written or recorded narrative shall be provided with the video. Engineer shall be notified 72 hours in advance making the video. Contractor is responsible for all costs associated with video and shall be considered a subsidiary part of the contract.

DOCUMENT 00815**SUPPLEMENTARY CONDITIONS**

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 Edition) and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

SC-1 The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 Edition) have the meanings assigned to them in the General Conditions.

SC-2.05.A.4 Add the following new paragraph to the General Conditions after paragraph 2.05.A.3:

4. "A schedule of anticipated shipping dates for materials and equipment. It is intended that equipment and materials be so scheduled as to arrive at the job site just prior to time for installation to prevent excessive materials on hand for inventory and necessity for extensive storage facilities at the job site."

SC-5.04.B.7 Add the following new paragraph to the General Conditions after paragraph 5.04.B.6:

7. Bonding surety shall be located in the state in which the work is being performed.

The Contractor shall not commence work under this contract until it has obtained all the insurance required under this paragraph and such insurance has been accepted by the Owner, nor shall the Contractor allow any Subcontractor to commence work on its subcontract until the insurance required of the Subcontractor has been so obtained and accepted.

- a. Compensation and Employer's Liability Insurance: The Contractor shall take out and maintain during the life of the contract, the statutory Worker's Compensation and Employer's Liability Insurance for all of its employees to be engaged in work on the project under the contract and, in case such work is sublet, the Contractor should require the Subcontractor similarly to provide Worker's Compensation and Employer's Liability Insurance for all the latter's employees to be engaged in such work.
- b. Bodily Injury Liability and Property Damage Liability Insurance: The Contractor shall take out and maintain during the life of the contract, Bodily Injury Liability and Property Damage Liability Insurance. The policy shall protect Contractor and any Subcontractor performing work covered by the contract from claims for damages or personal injury, including accidental death, as well as from claims for property damage, which may arise from

operations under the contract, whether such operations be by Contractor, Subcontractor, or by anyone directly or indirectly employed by either of them and the amount of such insurance should be not less than:

- (1) Bodily Injury Liability Insurance, in an amount not less than \$1,000,000.00 for injuries, including wrongful death to any one person and subject to the same limit for each person in an amount not less than \$2,000,000.00 on account of one accident. Contractual liability should be endorsed on the policy.
- (2) Property Damage Insurance in an amount not less than \$1,000,000.00 for damages on account of any one accident, and in an amount not less than \$2,000,000.00 for damages on account of all accidents.

- c. Builder's Risk Insurance (Fire and Extended Coverage): The Contractor shall have adequate fire and standard extended coverage, with a company or companies acceptable to the Owner, in force on the project.

The provisions with respect to Builder's Risk Insurance shall in no way relieve the Contractor of its obligation of completing the work covered by the Contract.

- d. Proof of Carriage of Insurance: The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations, effective dates, and date of expiration of policies. Such certificates shall contain substantially the following statement: "The insurance covered by this certification shall not be canceled or materially altered, except after 10 days written notice has been received by the Owner."

SC-6.02.B Add the following:

The Contractor shall provide in writing any requests to work on weekends & holidays. Requests shall be submitted to the Owner and Engineer for consideration a minimum of 48 hours prior to the requested weekend & holidays.

The contractor shall credit the JWSC by change order for inspection services for overtime work on work performed on Sundays or legal holidays. The amount of credit to JWSC shall be \$50.00 per hours, per inspection services.

SC-6.05.E Replace with the following:

Engineer's Cost Reimbursement: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner and Owner shall pay Engineer for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner and

Owner shall pay Engineer for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

SC-6.08 Add the following:

The Contractor shall not proceed until all encroachment permits, curb cut permits, highway crossing permits, and railroad crossing permits have been secured. Contact Owner to ascertain status of permits.

SC-6.09.D Add a new paragraph after paragraph 6.09.C of the General Conditions that reads as follows:

"D. The Contractor shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 as amended through January 1, 2004 (PL 91-596) and under Section 107 of the Contract Work and Safety Standards Act (PL 91-54). The regulations are administered by the Department of Labor and the Contractor shall allow access to the project to personnel from that Department.

The Bidder's attention is directed to the fact all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout and they will be deemed to be included in the contract the same as though herein written in full.

The Contractor shall keep fully informed of all laws, ordinances and regulations of Federal, State, City and County, in any manner affecting those engaged or employed in the work, or the materials used in the work, or in any way affecting the conduct of the work, and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. Contractor shall at all times, observe and comply with all such existing and future laws, ordinances, and regulations."

SC-6.12.B Add a new paragraph after paragraph 6.12.A of the General Conditions that is to read as follows:

"B. Record Data Drawings:

1. The Contractor shall keep accurate, legible records of the elevations, locations, types, and sizes of sanitary sewage lines, service laterals, manholes, cleanouts, water lines, fittings, valves, hydrants, drainage pipes, drainage structures, and other related work performed under this project. Where proposed and existing utilities cross, the Contractor shall measure and record the horizontal location and vertical separation between each crossing. Separation shall be measured between exteriors of pipes. On a set of project prints provided by the Owner, the Contractor shall prepare a set of "record" drawings from the data stated above. The horizontal locations of all portions of items installed on this project shall be accurately tied down to features that

are physical and visible, such as property corner markers and/or permanent type structures. Invert and frame elevations of all manholes, storm sewers and structures, sanitary sewers and lift stations shall be clearly indicated. These "record" drawings shall be kept clean and dry and maintained in a current state with the progress of the work. If at any time, a copy of this plan or portion of it is requested by the Owner, such copy shall be made available within 24 hours after the request is made.

2. Before final acceptance of the completed installation and before final payment by the Owner, the Contractor shall deliver to the Engineer a completed set of "record" drawings accurately depicting the data described above. The horizontal and vertical locations as shown on the "record" drawings for the items installed on this project shall be certified by a licensed surveyor. "Record" Drawings shall be submitted on a marked up set of project construction prints or electronically. Goodwyn Mills & Cawood shall prepare original "record" drawings from the submitted data. When completed, Goodwyn Mills & Cawood shall have the licensed surveyor stamp and sign the original "record" drawings before making copies available to the Owner or other appropriate agencies."

SC-6.13.A.3 Add the following:

"Safely guard the Owner's property from damages, injury, or loss in connection with this contract. Contractor shall at all times guard and protect its own work and all materials of every description both before and after being used in the work.

Contractor shall provide any enclosing or special protection from weather deemed necessary by Engineer without additional cost to the Owner. Partial payments under the contract will not relieve the Contractor from responsibility for protection of material, work, and property."

SC-9.02.C Add a new paragraph after paragraph 9.02.B of the General Conditions that is to read as follows:

"C. If at any time before the commencement or during the progress of the work, tools, plant or equipment appear to the Engineer to be insufficient, inefficient, or inappropriate to secure the quality of the work required or the proper rate of progress, the Engineer may order the Contractor to increase their efficiency, to improve their character, to augment their number, or to substitute new tools, plant or equipment as the case may be, and the Contractor must conform to such order; but a failure of the Engineer to demand such increase or efficiency, number, or improvements, shall not relieve the Contractor's obligation to secure the quality of work and the rate of progress necessary to complete the work within the time required by this contract to the satisfaction of the Owner."

SC-9.05 Add the following sentence at the end of paragraph 9.05 of the General Conditions:

"Owner and Engineer have the right to reject defective materials. Defective materials shall not be used in the work."

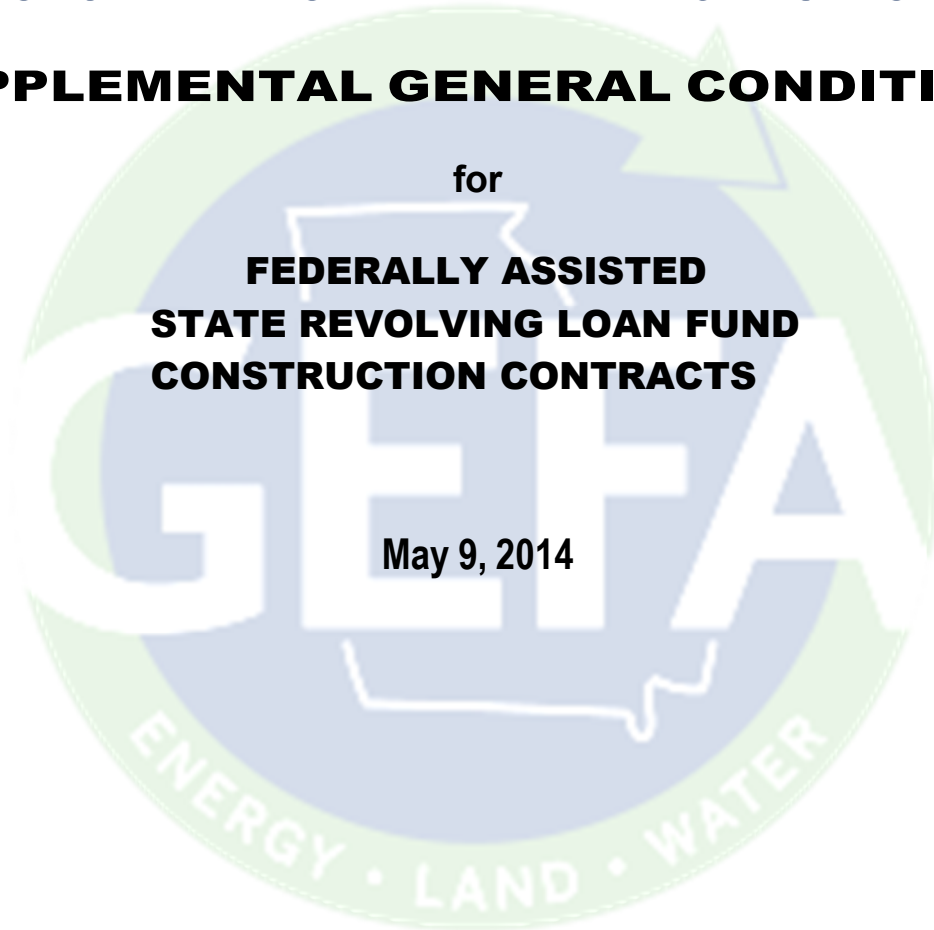
SC-13.03.A Add the following sentences to paragraph 13.03.A of the General Conditions:

"The Contractor will be required to maintain all work in a condition acceptable to the Engineer for a 30-day operating period after the same has been completed as a whole, and the Engineer has notified the Contractor in writing that the work has been finished. The Contractor shall give the Project Engineer or Project Representative a minimum of 48 hours notice for all required observations and tests."

END OF SUPPLEMENTARY CONDITIONS

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

SUPPLEMENTAL GENERAL CONDITIONS



The following standard language must be incorporated into construction contract documents and in all solicitations for offers and bids for all construction contracts or subcontracts in excess of \$10,000 to be funded in whole or in part by the Federally-assisted State Revolving Fund in the State of Georgia.

These Supplemental General Conditions shall not relieve the participants in this project of responsibility to meet any requirements of other portions of this construction contract or of other agencies, whether these other requirements are more or less stringent. The requirements in these Supplemental General Conditions must be satisfied in order for work to be funded with the State Revolving Fund.

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INSTRUCTIONS & GENERAL REQUIREMENTS

It is the policy of the State Revolving Loan Fund (SRF) to promote a fair share of subcontract, materials, equipment and service awards to small, minority, and women-owned businesses for equipment, supplies, construction, and services. Compliance with these contract provisions is required in order for project costs to be eligible for SRF funding. The fair share objective is a goal, not a quota. Failure on the part of the apparent successful bidder to submit required information to the loan recipient (Owner) may be considered by the Owner in evaluating whether the bidder is responsive to bid requirements.

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER:

A. Before beginning the work of any contract:

- 1) **DBE Compliance Form and related documentation.** The Owner must submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with Disadvantaged Business Enterprise (DBE) requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. (Pages GEFA-4&5)
- 2) **Certification Regarding Equal Employment Opportunity.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form, and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA-9)
- 3) **Certification Regarding Debarment, Suspension, & Other Responsible Matters.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA- 10)
- 4) ***EPA Form 6100-2 DBE Subcontractor Participation Form.** This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from the Prime Contractor, how much the DBE subcontractor was paid, and any concerns the DBE subcontractor might have. The Prime Contractor must provide this form to each DBE subcontractor. The DBE subcontractor can, as an option, complete and submit this form to the GEFA DBE Coordinator, who will also forward the form to the EPA DBE Coordinator. (Page GEFA-11)
- 5) ***EPA Form 6100-3 DBE Subcontractor Performance Form.** This form captures the description of work to be performed by an intended DBE subcontractor and the price of the work. This form is to be provided by the Prime Contractor to each DBE subcontractor and submitted with the DBE Compliance Form. (Page GEFA-12)
- 6) ***EPA Form 6100-4 DBE Subcontractor Utilization Form.** This form captures intended or anticipated use of an identified DBE subcontractor by the Prime Contractor and the estimated dollar amount of the work. This form is to be completed by the Prime Contractor and submitted with the DBE Compliance Form. (Page GEFA-13)

*** 6100 FORMS ARE NOT REQUIRED WHEN ALL OF THE WORK IS SELF-PERFORMED BY THE PRIME CONTRACTOR.**

B. During the performance of the contract:

- 7) **Changes to Subcontractors Form.** If any changes, substitutions, or additions are proposed to the subcontractors included in previous GEFA concurrences, the Owner must submit this information to GEFA for prior concurrence in order for the affected subcontract work to be eligible for SRF funding. (Page GEFA-14)
- 8) **DBE Annual Report.** The Owner must submit this information to GEFA no later than October 20th of any year that the construction contract is active. (Page GEFA-15)
- 9) **Certified Payrolls.** These should be submitted to the Owner weekly for the Prime Contractor and all subcontractors. The Owner must maintain payroll records and make these available for inspection. Use Department of Labor form WH-347 or a similar form that contains all of the information on the Department of Labor.

THE OWNER MUST SUBMIT INFORMATION FOR GEFA REVIEW AND CONCURRENCE TO:

Georgia Environmental Finance Authority
Attention: DBE Compliance Coordinator
233 Peachtree Street, N.E.
Harris Tower, Suite 900
Atlanta, Georgia 30303
(404)584-1000; (404)584-1069 (fax)
dbecompliance@gefa.ga.gov

DBE COMPLIANCE FORM

ALL INFORMATION OUTLINED ON THIS FORM IS REQUIRED FOR DBE COMPLIANCE REVIEW. THE PROPOSED PRIME CONTRACTOR AND OWNER SHOULD ENSURE THAT THIS INFORMATION IS COMPLETE PRIOR TO SUBMITTAL.

Loan Recipient _____

SRF Loan Number _____

PRIME CONTRACTOR'S AND OWNER'S CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants and that EPA Forms 6100-2 and 6100-3 were distributed to all DBE subcontractors.

(Prime Contractor signature)

Date _____

(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

(Signature of Owner or Owner's representative)

Date _____

(Printed name and title)

CONTACT INFORMATION

Owner contact _____

Owner phone number & email _____

Consulting Engineer contact _____

Consulting Engineer phone number & email _____

Proposed Prime Contractor _____

Prime Contractor contact _____

Prime Contractor phone number & email _____

Proposed total contract amount \$ _____

Proposed total MBE participation \$ _____ Percentage _____ Goal: 4.0 percent

Proposed total WBE participation \$ _____ Percentage _____ Goal: 4.0 percent

CONTINUED ON NEXT PAGE

Please submit the following with the DBE Compliance Form:

- 1) List of all committed and uncommitted subcontractors by trade, including company name, address, telephone number, contact person, dollar amount of subcontract, and DBE/MBE/WBE status.
- 2) Indicate in writing if no solicitations were made because the Prime Contractor intends to use only its own forces to accomplish the work.
- 3) Proof of certification by EPA, SBA, DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA criteria) for each subcontractor listed as a DBE, MBE, or WBE.
- 4) Documentation of solicitation efforts for prospective DBE firms, such as fax confirmation sheets, copies of solicitation letters and e-mails, printout of online solicitations, printouts of online search results and copies and affidavits of publication in newspapers or other publications. (see also, "**Six Good Faith Efforts**", page GEFA-7).
 - a. The Prime Contractor shall use the necessary resources to identify and directly solicit no less than 3 certified MBE firms and 3 certified WBE firms to bid in each expected subcontract trade or area. If a diligent and documented search of the recommended directories does not identify 3 potential certified MBE firms and 3 potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource.
 - b. The Prime Contractor is encouraged to follow-up each written, fax, or e-mail solicitation with at least 1 logged phone call.
 - c. Whenever possible, post solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
- 5) Written justification for not selecting a certified DBE subcontractor that submitted a low bid for any subcontract area.
- 6) Certification By Proposed Prime Contractor or Subcontractor Regarding Equal Employment Opportunity (GEFA-9)
- 7) Certification By Proposed Prime or Subcontractor Regarding Debarment, Suspension, and Other Responsible Matters. (GEFA-10)
- 8) *EPA Form 6100-3 DBE Subcontractor Performance Form for all DBE subcontracts. (GEFA-12)
- 9) *EPA Form 6100-4 DBE Subcontractor Utilization Form for all DBE subcontracts. (GEFA-13)

*6100 forms are not required when all of the work is self-performed by the prime contractor.

END OF DBE COMPLIANCE FORM



DBE COMPLIANCE CHECKLIST

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER BEFORE THE WORK BEGINS:

Loan Recipient _____

SRF Loan Number _____

Include in Package Submittal

PRIME CONTRACTOR ONLY	TOTAL CONTRACT AMOUNT	
ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT
ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT
DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT
DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT
PRIME CONTRACTOR ONLY (Not applicable if self-performing all work, with no subcontracting)		

1. **DBE Compliance Form.** The Owner must sign and submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with DBE requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. **(Pages GEFA-4&5)**

2. **Certification Regarding Equal Employment Opportunity.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-9)**

3. **Certification Regarding Debarment, Suspension, & Other Responsible Matters.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-10)**

4. **EPA Form 6100-2 DBE Subcontractor Participation Form.** This form gives a DBE subcontractor the opportunity to describe the work the DBE subcontractor received from Prime Contractor, how much the DBE subcontractor was paid, and any other concerns the DBE subcontractor might have. The Prime Contractor must provide this form to each DBE subcontractor. The DBE subcontractor can, as an option, submit this form to the GEFA DBE Coordinator, who will forward the form to the EPA DBE Coordinator. **(Page GEFA-11)**

5. **EPA Form 6100-3 DBE Subcontractor Performance Form.** This form captures an intended DBE subcontractor's description of work to be performed for the Prime Contractor and the price of the work. This form is to be provided by the Prime Contractor to each DBE subcontractor and submitted with the DBE Compliance Form. **(Page GEFA-12)**

6. **EPA Form 6100-4 DBE Subcontractor Utilization Form.** This form captures the Prime Contractor's intended use of an identified DBE subcontractor and the estimated dollar amount of the work. This form is to be completed by the Prime Contractor and submitted with the DBE Compliance Form. **(Page GEFA-13)**

Uncommitted Trades

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Documentation of Good Faith Efforts

Newspaper ads	Internet Websites	Fax Confirmation	Copies of Solicitation Emails/letters	Copies of phone logs
PROOF OF CERTIFICATION FOR EACH SUBCONTRACTOR LISTED AS A DBE, MBE, OR WBE				

SIX GOOD FAITH EFFORTS

These good faith efforts are required methods to ensure that DBEs have the opportunity to compete for procurements funded by EPA financial assistance dollars. Such good faith efforts are described as follows:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. This will include placing DBEs on solicitation lists and soliciting them whenever there are potential sources.
2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
5. Use the resources, services, and assistance of the Department of Transportation (DOT), Small Business Administration (SBA), and the Minority Business Development Agency of the Department of Commerce (MBDA).
6. If the Prime Contractor awards subcontracts, it must take the steps described in items (1) through (5) listed above.

Please note that DBEs, MBEs, and WBEs must be certified by EPA, SBA, or DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's). DBEs must be certified in order to be counted toward the Prime Contractor's MBE/WBE goals. "Self-certified" DBE subcontractors will not be counted toward the Prime Contractor's MBE/WBE goals. Depending upon the certifying agency, a DBE may be classified as a DBE, a Minority Business Enterprise (MBE), or a Women's Business Enterprise (WBE).

The Prime Contractor must employ and document the **Six Good Faith Efforts** for all subcontracts, even if the Prime Contractor has achieved the fair share objectives.

The documentation of solicitations for the **Six Good Faith Efforts** must be detailed in order to allow for satisfactory review. Such documentation might include fax confirmation sheets, copies of solicitation letters/emails, printouts of the online solicitations, printouts of online search results and affidavits of publication in newspapers or other publications. The Prime Contractor is encouraged to follow up each written, fax, or e-mail solicitation with at least 1 logged phone call.

The Prime Contractor should attempt to identify and solicit DBEs in the geographic proximity of the project before soliciting those located farther away.

If a DBE subcontractor fails to complete work under the subcontract for any reason, the Prime Contractor must notify the Owner in writing prior to any termination and must employ the Six Good Faith Efforts described above if using a replacement subcontractor. Any proposed changes from the approved DBE subcontractor list must be reported to the Owner and to GEFA on the *Changes to Approved Subcontractors Form* (GEFA-14) prior to initiation of the action. EPA Forms Nos. 6100-3 and 6100-4 must also be submitted to GEFA for new DBE subcontracts.

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTORS

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTOR'S FOR DIRECT SOLICITATION:

Georgia Department of Transportation (GDOT)
Disadvantaged Business Enterprise Program
(404) 631-1972

http://tomcat2.dot.state.ga.us/ContractsAdministration/uploads/rptDBE_Directory_CA_New.pdf

City of Atlanta, Georgia
Office of Contract Compliance
(404) 330-6010
<http://pro.prismcompliance.com/>

DeKalb County, Georgia
Office of Purchasing and Contracting
(404) 371-4730
<http://www.co.dekalb.ga.us/purchasing/pdf/supplierList.pdf>

Fulton County, Georgia
Purchasing and Contract Compliance
(404) 612-5800
http://www.fultoncountyga.gov/plugins/content/external_links/frameset.php?url=http%3A%2F%2Fwww.occfultoncountyga.com%2FDirectory%2FMBEDirectoryExternal.aspx

Metropolitan Atlanta Rapid Transit Authority (MARTA)
Disadvantaged Business Enterprise Program
(404) 848-4656
<http://www.itsmarta.com/vendor-opportunities.aspx>

United States Environmental Protection Agency
http://www.epa.gov/osbp/dbe_team.htm
Teree Henderson
National DBE Program Coordinator
(202) 566-2222
henderson.teree@epa.gov

Georgia Environmental Finance Authority
DBE Compliance Coordinator
(404) 584-1000
www.gefa.ga.gov
db_compliance@gefa.ga.gov

NOTES:

- (1) The Prime Contractor shall use the necessary resources to identify and directly solicit no less than 3 certified MBE firms and 3 WBE firms to bid in each expected subcontract area or trade.
- (2) If a diligent and documented search of the recommended directories does not identify 3 potential certified MBE firms and 3 potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
- (3) Expenditures to a DBE that acts merely as a broker or passive conduit of funds, without performing, managing, or supervising the work of its subcontract in a manner consistent with normal business practices may not be counted.
- (4) The Prime Contractor should attempt to identify and first solicit DBEs in the geographic proximity of the project before soliciting those located farther away.
- (5) Contact the GEFA DBE Compliance Coordinator at (404) 584-1000 or db_compliance@gefa.ga.gov for further assistance or resources.

**CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR
REGARDING
EQUAL EMPLOYMENT OPPORTUNITY**

Proposed Prime Contractor
Proposed Subcontractor

This certification is required pursuant to Executive Order 11246, Part II, Section 203 (b), (30 F.R. 12319-25). Any bidder or prospective prime contractor, or any of the proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicated that the prime or subcontractor has not filed a compliance report due under applicable instruction, such contractor shall be required to submit a compliance report.

(1) Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause.
YES _____ NO _____

(2) Compliance Reports were required to be filed in connection with such contract or subcontract.
YES _____ NO _____ (If YES, state what reports were filed and with what agency.)

(3) Bidder has filed all compliance reports due under applicable instructions, including SF-100 (EEO-1 Report).
YES _____ NO _____ (If NO, please explain in detail.)

The information above is true and complete to the best of my knowledge and belief. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

PRINTED NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

SIGNATURE OF AUTHORIZED REPRESENTATIVE

DATE

**CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR
REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBLE MATTERS**

Proposed Prime Contractor
Proposed Subcontractor

Under Executive Order 12549 individuals or organizations debarred from participation in Federal Assistance Programs may not receive an assistance award under federal program or sub-agreement there under for \$25,000 or more. Accordingly each recipient of a State loan or a contract (engineering or construction) awarded under a loan must complete the following certification (see 40 CFR 32.510).

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

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.
- (b) Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and
- (d) Have not within a three year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause of default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

PRINTED NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

SIGNATURE OF AUTHORIZED REPRESENTATIVE

DATE

_____**I am unable to certify to the above statements. My explanation is as follows:**

Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Participation Form

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

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

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

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

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

Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Performance Form

This form is intended to capture the DBE¹ subcontractor's² description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

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

Contract Item Number	Description of Work Submitted to the Prime Contractor Involving Construction, Services , Equipment or Supplies	Price of Work Submitted to the Prime Contractor
DBE Certified By: ___DOT ___SBA ___Other: _____		Meets/ exceeds EPA certification standards? ___YES ___NO ___Unknown

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

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

Disadvantaged Business Enterprise (DBE) Program DBE Subcontractor Utilization Form

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE¹ subcontractors² and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

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

I have identified potential DBE certified subcontractors	___ YES	___ NO	
If yes, please complete the table below. If no, please explain:			
Subcontractor Name/ Company Name	Company Address/ Phone/ Email	Est. Dollar Amt	Currently DBE Certified?

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

CHANGES TO APPROVED SUBCONTRACTORS FORM

Loan Recipient _____ SRF Loan Number _____

CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants.

(Prime Contractor signature) Date _____

(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

(Signature of Owner or Owner's representative) Date _____

(Printed name and title)

GENERAL INFORMATION:

- 1) If an approved subcontractor is terminated or replaced, please identify this company and briefly state reason.

Subcontractor Name::	Trade
Reason Terminated or Replaced	

- 2) For new or additional subcontractors, list name, trade, address, telephone number, contact person, dollar amount of subcontract, and DBE status.

New Subcontractor Name and Contact Person	Trade
Address	Telephone Number
Dollar Amount	DBE Status

- 1) Attach proof of certification by EPA, SBA, DOT (or by state, local, Tribal, or private entities whose certification criteria match EPA's) for each subcontractor listed as a DBE, MBE, or WBE.
- 2) Attach documentation of Six Good Faith Efforts solicitation effort for all new subcontracts.
- 3) Provide justification for not selecting any certified DBE subcontractor that submitted a low bid for any subcontract area.

- 4) For each subcontractor, attach certifications regarding Equal Employment Opportunity (GEFA-9) and certifications regarding Debarment, Suspension, and Other responsible Matters (GEFA-10)

DBE ANNUAL REPORT
FORM (5700-52A)

This form must be completed by recipients of federal financial assistance for procurement of supplies, equipment, construction or services. SRF loan recipients are required to submit this report to GEFA by the 20th of October for the previous period of October 1 through September 30. Please submit a "negative" report even if \$0 is the amount paid to MBE/WBE subcontractors during the reporting period.

ANNUAL REPORT FORM (5700-52A)			
1. PRIME CONTRACTOR		2. REPORTING PERIOD (Complete date using current year.) Period Ending (September 30, _____)	
3. SUBMIT TO: Georgia Environmental Finance Authority Attention: DBE Compliance Coordinator 233 Peachtree Street, N.E. Harris Tower, Suite 900 Atlanta, Georgia 30303 dbe_compliance@gefa.ga.gov		4. LOAN RECIPIENT (Name, Address and Telephone)	
5. LOAN RECIPIENT (OWNER) REPORTING CONTACT	PHONE:	6. TYPE OF FEDERAL FINANCIAL ASSISTANCE PROGRAM (Check one) CWSRF _____ DWSRF _____	7. SRF LOAN NUMBER
8. CONTRACTOR NAME & TOTAL CONSTRUCTION CONTRACT AMOUNT		9. ACTUAL DOLLAR AMOUNT PAID TO MBE/WBE SUBCONTRACTORS THIS PERIOD \$ MBE _____ \$ WBE _____ NEGATIVE REPORT (\$0) _____	
10. RECIPIENT'S MBE/WBE GOALS MBE 4.0 % WBE 4.0 %		11. TOTAL DOLLARS SPENT THIS PERIOD MBE \$ _____ WBE \$ _____ NON MBE/WBE \$ _____ TOTAL \$ _____	
12. NAME & TITLE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT (OWNER).		13. SIGNATURE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT.	14. DATE
MBE/WBE PAYMENTS MADE DURING PERIOD			
NAME & ADDRESS of DBE (SUB)CONTRACTOR (indicate if MBE or WBE firm)		TOTAL DOLLAR AMOUNT PAID & DATE PAID \$ _____ DATE _____	

SPECIAL PROVISIONS

- (a) The Prime Contractor is required to pay its subcontractors in accordance with the Georgia Prompt Payment Act (OCGA 13-11).
- (b) The Prime Contractor is required to insert the entirety of the Davis Bacon contract requirements into all subcontracts
- (c) Sewer line and water line crossing of all roads and streets shall be done in accordance with the Georgia Department of Transportation (D.O.T.) Policies and Procedures and must comply with the Ga. D.O.T. Standard Specifications, Construction of Roads and Bridges, 1993 Edition.
- (c) Construction shall be carried out so as to prevent bypassing of wastewater flow and to prevent interruption of drinking water treatment during construction. EPD must receive written notification prior to any reduction in the level of treatment and must approve all temporary modifications to the treatment process prior to the activity.
- (d) Erosion and Sedimentation Control shall be accomplished in accordance with the Georgia Erosion and Sedimentation Control Act of 1975 as currently amended and NPDES General Permits (Storm Water from Construction Sites). See also www.gaepd.org and www.gaswcc.georgia.gov for information regarding permits.
- (e) **Use of Chemicals:** All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer reactant or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in conformance with State and local regulations as appropriate.
- (f) It is the duty of the Prime Contractor, the Owner and the Engineer to ensure the construction of the project, including the letting of contracts in connection therewith, shall comply with all applicable laws and regulations and requirements of the United States of America or any agency thereof, the state of Georgia or any agency thereof, territorial, or any local government laws or political subdivision and ordinances to the extent that such requirements do not conflict with Federal laws and this subchapter.
- (g) EPD, EPA, and GEFA shall have access to the site and the project work at all times.

BONDS

Bonding requirements for Contracts of \$100,000 or less are contained in the General Conditions. Bond requirements of contracts in excess of \$100,000 are:

1. Bid guarantee equivalent to five percent of the bid price. The bid guarantee shall consist of a firm commitment such as a certified check or bid bond submitted with the bid.
2. Performance bond equal to 100 percent of the contract price and;
3. Payment bond equal to 100 percent of the contract price. Bonds must be obtained from companies holding Certificates of Authority as acceptable sureties, issued by the U.S. Treasury.

SPECIAL NOTICE TO BIDDERS

By the submission of this bid, each bidder acknowledges that he understands and agrees to be bound by the equal opportunity requirements of EPA regulations (40 CFR Part 8, particularly Section 8.4 (b)), which shall be applicable throughout the performance of work under any contract awarded pursuant to this solicitation. Each bidder agrees that if awarded a contract, it will similarly bind contractually each subcontractor. In implementation of the foregoing policies, each bidder further understands and agrees that if awarded a contract, it must engage in affirmative action directed at promoting and ensuring equal employment opportunity in the workforce used under the contract (and that it must require contractually the same effort of all subcontractors whose subcontracts exceed \$10,000.00). The bidder understands and agrees that "affirmative action" as used herein shall constitute a good faith effort to achieve and maintain minority employment in each trade in the on-site workforce used on the project.

EQUAL EMPLOYMENT OPPORTUNITY NOTICE

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the Equal Opportunity Clause which is included in the nondiscrimination Provision and Labor Standards, EPA Form 5720-4 and the Standard Federal Equal Employment Opportunity (EEO) Construction Contract Specifications set forth herein.
2. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	4.0 percent
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Goals for female participation for each trade	4.0 percent
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These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minority and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation to the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract.
4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical area where the contract is to be performed giving the state, county and city, if any).

EEO Construction Contract Specifications (Executive Order 11246)

EEO Specifications:

1. As used in these specifications:
 - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
 - b. "Director" means Director, Office of Federal Contract Compliance Program, United States Department of Labor, or any person to whom the Director delegates authority;
 - c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form, 941.
 - d. "Minority" includes:
 - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
 - (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.
4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. The Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
 - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever actions the Contractor may have taken.
 - d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
 - e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trained programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7(b) above.
 - f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
 - h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
 - i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
 - j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.
 - k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
 - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
 - m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
 - n. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations 7(a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant may be asserted as fulfilling any one or more of its obligations under 7(a) through (p) of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes

a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).
10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation, if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

Davis-Bacon and Related Acts

Labor Standards Provisions for Federally Assisted Contracts

Contract Provision for Contracts in Excess of \$2,000.

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, <http://www.dol.gov/whd/govcontracts/dbra.htm> (E-tools)

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly

payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/whd/forms> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the

meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

Contract Provision for Contracts in Excess of \$100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job

(5) Compliance Verification:

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors' use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must provide a report of compliance to the Georgia Environmental Finance Authority detailing compliance efforts and results. This report will be submitted with or prior to the loan recipient's first request for funding of construction costs, prior to final disbursement of funds from the loan, and as requested by the GEFA during the project.

(f) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB coordinator and to the appropriate DOL Wage and Hour District Office listed at <http://www.dol.gov/whd/america2.htm>.

INSERT WAGE RATE DETERMINATION HERE

Wage Rates (for *Heavy Construction*) are state/county specific can be found at:

<http://www.dol.gov/whd/govcontracts/dbra.htm>

Sample Payroll Form (WH-347) is found at:

<http://www.dol.gov/whd/forms/wh347.pdf>

Labor Standards Interview Form (SF-1445) is found at:

<http://www.gsa.gov/portal/forms/download/115910>

Davis-Bacon (WH-1321) poster is found at:

<http://www.dol.gov/whd/regs/compliance/posters/fedprojc.pdf>
(English)

<http://www.dol.gov/whd/regs/compliance/posters/davispan.pdf>
(Spanish)

Fair Labor Standards Act Minimum Wage poster is found at:

<http://www.dol.gov/whd/regs/compliance/posters/minwagebwp.pdf>
(English)

<http://www.dol.gov/whd/regs/compliance/posters/minwagespbwP.pdf>
(Spanish)

“EEO Is the Law” poster is found at:

http://www.eeoc.gov/employers/upload/eeoc_self_print_poster.pdf
(English)

http://www.eeoc.gov/employers/upload/eeoc_self_print_poster_spanish.pdf
(Spanish)

“EEO Is the Law” poster supplement is found at:

http://www.eeoc.gov/employers/upload/eeoc_gina_supplement.pdf
(English)

http://www.eeoc.gov/employers/upload/eeoc_gina_supplement_spanish.pdf
(Spanish)

OSHA poster is found at:

<http://www.osha.gov/Publications/osha3165low-res.pdf>
(English)

<http://www.osha.gov/Publications/osha3167.pdf>
(Spanish)

CERTIFIED PAYROLL REVIEW CHECKLIST

(This is a *recommended Certified Payroll Review Checklist for the Owner's use.*)

CONTRACT ID City of CW/DWSRF#00 - 000	PRIME CONTRACTOR/SUBCONTRACTOR X Construction
GENERAL WAGE DECISION AND DATE (Insert number & date)	PAYROLL PERIOD ENDING

INSTRUCTIONS: This checklist is to be used in conjunction with projects requiring Davis-Bacon Wage Rates and compliance reviews. All certified payrolls are to be date stamped upon receipt from the prime contractor.

Payroll Information Checklist:

- _____ Prime Contractor's or subcontractor's name and address
- _____ Contract ID numbers (GEFA SRF No.)
- _____ Week ending.
- _____ Project location.

- _____ Employee ID or Last 4 digits of Social Security Number
 - _____ Social Security Number removed
 - _____ Employee's work classification
 - _____ Identification of OJTs, apprentices and program levels (%) on payrolls.
 - _____ Verify that OJT and Apprentice Program documentation is in project files.

- _____ Daily and weekly employee hours worked in each job classification.
 - _____ Daily and weekly employee overtime (or premium) hours worked
 - _____ Total weekly hours worked on all jobs (prevailing and non-prevailing wage).
 - _____ Base rate shown for each employee, overtime (or premium) rate shown when worked.
 - _____ Verify correct wage rates are being paid.
 - _____ Verify overtime is being paid correctly (over 40 hrs/wk, and Time and a half)
 - _____ Week's gross wages
 - _____ Week's itemized deductions.
 - _____ Week's net wages paid

- _____ Compliance statement attached.
 - _____ Method of fringe benefit payment described by checking either box (4)(a) or (4)(b).
 - _____ Fringe benefit package information in file and updated as needed (if 4(a) is checked)

____ Exceptions explanation for fringe benefit (4)(c).
____ Signature.

Compliance Review Checklist (for field reviews):

____ Verify work classifications reported are consistent with the work
____ performed. Compare payrolls with wage rate interviews when
____ conducted.
Compare number of employees and hours worked with project documentation.

REVIEWED BY:

DATE

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Contractor-furnished.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

- B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: **2019 WPCF REHABILITATION ACADEMY CREEK**

1. Project Location: **Brunswick, GA**

- B. Owner: **Brunswick-Glynn County Joint Water & Sewer Commission**

1. Owner's Representative(s): **Goodwyn Mills & Cawood**

- C. Engineer: Goodwyn Mills & Cawood; **Savannah, GA**

- D. Engineer's Consultants: The Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Electrical – **Chatham Engineering; Savannah, GA**
2. Structural- **Weatherford & Day Engineers; Montgomery, AL**

3. Mechanical- Pruett, Ford & Associates; Atlanta, GA

E. Contractor: TBD.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The construction and modifications consist of the following:

- a. Civil/site work and miscellaneous.
- b. Yard piping modifications
- c. Installation of new tertiary filtration
- d. Demolition and replacement of influent bar screens
- e. Installation of Biofilter Odor Treatment System
- f. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
- g. Construction of Main Flow Split Structure and attendant yard piping modifications.
- h. Gate replacement at three clarifier flow split structures
- i. Modification of RAS feed to each of three existing Aeration Basins
- j. Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers.(Additive Alternate No. 2)
- k. Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers.(Additive Alternate No. 3)
- l. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)
- m. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
- n. Modification of Belt Press feed piping.
- o. Miscellaneous valves and piping.
- p. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)
- q. Plant-wide fiber-optic network.
- r. Electrical work and controls.

B. Type of Contract:

1. Project will be constructed as a design-bid-build contract.

1.5 CONTRACTOR-FURNISHED AND INSTALLED PRODUCTS

A. Contractor shall furnish all products indicated in the bid documents. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work, or to retain other Contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways and loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Engineer will prepare a Certificate of Substantial Completion for each specific phase of the project.
 - 2. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.

1.8 PHASING OF PROJECT WORK

- A. Yard piping modifications
 - 1. Process interruptions shall be cleared by the OWNER via submittal to the ENGINEER.
- B. Installation of new influent manhole system
 - 1. Manholes shall be installed with required backup pumping to prevent surcharging in upstream manholes.
- C. Demolition and replacement of influent bar screens
 - 1. Shall be performed in a manner that allows at least one screen (existing or proposed) to be in operation at all times.

2. Gate replacement shall be coordinated with screen replacement to prevent screening structure down time.
- D. Installation of new tertiary filtration
1. Sufficient bulkheading and bypassing shall be provided to prevent Chlorine Contact Shutdown.
- E. Chemical Media Odor Treatment Polishing System (Additive Alternate No. 1).
1. Installation shall be coordinated with installation of odor control covers, and biological odor control system.
- F. Construction of Main Flow Split Structure and attendant yard piping modifications.
1. Shall be performed utilizing bypass pumps to prevent plant shutdowns.
- G. Gate replacement at three clarifier flow split structures, Installation of FRP Density Baffle Curtains in six existing Secondary Clarifiers. (Additive Alternate No. 2), and Installation of Energy Dissipating Feed wells in six existing Secondary Clarifiers. (Additive Alternate No. 3)
1. Work shall be coordinated with Energy Dissipating Feed Wells and FRP Density Baffles.
 2. Only two (2) clarifiers will be taken out of operation at a time. This shall be coordinated with the plant operation staff.
 3. Once the gate replacement has been completed and one (1) clarifier has been outfitted with Energy Dissipating Feed Wells and FRP Density Baffles that clarifier shall be placed back into service.
 4. After the one (1) clarifier has been placed back into service, work may begin on the second clarifier that is currently out of service.
- H. Modification of RAS feed to each of three existing Aeration Basins
1. Piping shall be laid and installed completely prior to preparation for tapping existing process lines.
 2. Flow control and measuring equipment shall be installed and tested prior to making process connections.
 3. AB 2 shall be the first connection
 4. AB 1 shall be installed connection
 5. AB 3 shall be the final connection
 6. Th connections are not required to be made in the same work day but they must be performed with-in one work week and at the end of each work day RAS shall still be provided to each AB.
- I. Rehabilitation of DAF building to Admin Building including improvements and upgrades to the Standby Power System (Additive Alternate No. 4)

1. Work shall be performed in a manner that minimizes the disruption to OWNER operation of the warehouse in the DAF building. Work plan shall be approved by the OWNER.
- J. Construction of Dewatering Sludge Unloading system inside Sludge Dewatering/Dryer Building. (Additive Alternate No. 5)
1. Work shall be completed after demolition of concrete wall structures in dewatering building. See DD701.
- K. Modification of Belt Press feed piping.
1. Will require a brief shutdown of the sludge dewatering system, this shutdown shall be scheduled with the plant operations staff
 2. Shutdown time shall be minimized by installing all lines up to tie-ins and making tie-ins at one time.
- L. Miscellaneous valves and piping.
1. Any required shutdowns must be communicated to the engineer and plant staff at least 5 business days prior to planned shutdown.
- M. Modifications to the Plant-wide SCADA system and appurtenant controls (Allowance Item)
1. Any required shutdowns must be performed in coordination with shutdowns required for process equipment installation.
 2. Shutdowns not requiring process equipment shutdown shall be scheduled with the OWNER
- N. Plant-wide fiber-optic network.
1. Any required shutdowns must be performed in coordination with shutdowns required for process equipment installation.
 2. Shutdowns not requiring process equipment shutdown shall be scheduled with the OWNER
- O. Electrical work and controls.
1. Any required shutdowns must be performed in coordination with shutdowns required for process equipment installation.
 2. Shutdowns not requiring process equipment shutdown shall be scheduled with the OWNER

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Working hours shall be generally limited to 7am to 5pm; Contractor shall contact the Engineer/Owner when working hours are extended beyond normal business hours or when weekend construction is expected to occur.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to neighbors with the Owner.
 1. Obtain Engineer's written permission before proceeding with disruptive operations.
- D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1.10 ADVERSE WEATHER

A. General

1. Notice of rain delay days with the documentation of the aforementioned sources herein and on-site records must be submitted by the Contractor to the Inspector/Engineer on the first working day of every month for the previous month or at the monthly construction meeting as determined at the preconstruction meeting.

B. Definition

1. Adverse weather is defined as the occurrence of a condition that prevents construction activity exposed to weather conditions or access to the site for more than four (4) hours in a day.
2. Adverse weather may also include, if appropriate, "dry-out" or "mud" days.
3. Adverse weather includes days that temperature does not rise above the required temperature for a construction activity.

C. Qualifications

1. Adverse weather conditions having a direct effect on construction progress are to be handled as follows:
 - a. Precipitation is to be measured by the Contractor using a precipitation gauge on-site. For each month, the number of days (24 hours) that the site experiences precipitation of 0.10 inches or more shall be totaled, confirmed with the Owner/Inspector, and reported to the Engineer.
 - b. For each month, the total number of days of 0.10 inches or more of precipitation shall be compared to the number of expected days for that month. The number of expected days of 0.10 inches or more of precipitation shall be established as follows:
 - 1) Identify National Oceanic and Atmospheric (NOAA) weather stations as shown at <https://gis.ncdc.noaa.gov/maps/ncei> within a 100-mile radius of the project location.
 - a) If multiple weather stations are found within 100 miles of the project site, the weather station that is the closest to the site shall be used.

Compile rain data from the previous 5 years and total the number of days with precipitation of 0.10 inches or more.

- b) If a weather station is not found within a 100-mile radius of the site, the following schedule shall be used:

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
5	5	5	4	7	7	8	9	5	4	4	6
(Data from NOAA, > 0.10" Daily Precipitation, January 2007 – December 2018, Savannah, GA)											

- c. Rain delay days will be approved by the Engineer and added to the contract duration only if they exceed the number of expected days for that given month.
2. Adverse weather conditions having an indirect effect due to precipitation are to be handled as follows:
- a. Precipitation that occurs beyond the standard baseline which results in “dry-out” or “mud” days.
- 1) The standard baseline is based on the NOAA’s Point Precipitation Frequency (PPF) Estimate for the construction area using the latitude and longitude for a 1-year average recurrence interval and a 60-min time period. This can be found at <http://dipper.nws.noaa.gov/hdsc/pfds/>.
3. Adverse weather conditions due to temperature are as follows:
- 1) Cold Weather concreting shall be per ACI 306.
- a) The Contractor shall have a calibrated thermometer onsite which is logged by the inspector and Contractor prior to any concrete pours during cold weather.
4. Adverse weather conditions due to wind speeds are as follows:
- a. Wind speeds exceeding those permissible to use equipment or to perform certain tasks safely, including but not limited to operating crane(s) or other aerial equipment for construction or erection of a building structure.
- 1) The Contractor shall have a calibrated wind speed gauge on-site.
5. Adverse weather conditions resulting in compromised project site conditions are as follows:
- a. Project site conditions such as mud, pooling of water, ice, or standing snow subsequent to the actual precipitation days, prevent the performance of activities such as, but not limited to, mass grading, building pad grading, foundations, piping, excavations, backfill, concrete, masonry, etc. operations.

D. Weather Delay Days

1. Adverse weather delay day may be counted if adverse weather prevents work on the project during an event where:

- a. Precipitation days for a specific month is greater than the recorded monthly average for a project location indicated above.
 - 1) The number of average rain days shall be subtracted from the number of recorded rain days and the difference shall be the allotted time.
- b. Precipitation for a given day is greater than the NOAA's PFF estimate indicated above.
 - 1) One (1) day for each day or consecutive days of precipitation that exceeds the standard baseline.
- c. Precipitation of 3.0 inches over a 24-hour period.
 - 1) The number of allotted days shall be at the discretion of the Engineer/Owner based on site conditions, working conditions, and type of construction.
 - 2) Temperature per ACI 306.

E. Exceptions

1. The Contractor shall take into account that certain construction activities are more affected by adverse weather and seasonal conditions than other activities, and that "dry-out" or "mud" days are not eligible to be counted as an Adverse Weather Delay Day until the standard baseline is exceeded. Hence, the Contractor should allow for an appropriate number of additional days associated with the Standard Baseline days in which such applicable construction activities are expected to be prevented and suspended.

F. Record Keeping

1. All Adverse Weather events shall be recorded by the on-site management team.
2. On-site records of daily rain and/or temperature readings shall be kept by the Contractor and may be accepted to verify weather and/or temperature variations which prevent earthwork, foundation and slabs, and/or roofing materials installation. The Inspector shall also be required to maintain on-site records of daily rain and/or temperature.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations.

1.12 WARRANTIES

- A. Warranties shall conform to the requirements of the General Conditions.
- B. All equipment supplied by the Contractor under these Specifications shall be warranted by the Contractor and the equipment manufacturers for a period of one (1) year. Warranty period shall commence on the date of Substantial Completion.
- C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail due to workmanship, design and materials during the warranty period, it shall be replaced by the Contractor and the unit(s) restored to service at no expense to the Owner.
- D. The manufacturer's warranty period shall run concurrently with the Contractor's warranty or guarantee period. No exception to this provision shall be allowed. The Contractor shall be responsible for obtaining equipment warranties from each of the respective suppliers or manufacturers for all the equipment specified.
- E. All work shall be performed as shown on the Drawings and as described in the Contract Documents and Technical Specifications.
- F. All work shall comply with standards described by the Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926, Subpart P, latest revision.

1.13 CONTRACT DRAWINGS

GENERAL	
G-001	TITLE SHEET
G-002	DRAWING INDEX
G-003	PROCESS FLOW DIAGRAM
G-004	HYDRAULIC PROFILE
G-005	GENERAL ABBREVIATIONS & LEGENDS
G-006	PROCESS PIPING SCHEDULE

INSTRUMENTATION	
I-001	P&ID - LEGEND
I-002	SITE PLAN - FIBER OPTIC NETWORK
I-003	P&ID - BLOCK DIAGRAM
I-101	P&ID - SCREENING
I-102	P&ID - GRIT REMOVAL
I-103	P&ID - INFLUENT PUMP STATION
I-201	P&ID - PRE-AERATION & FLOW SPLIT
I-301	P&ID- AERATION BASINS 1,2, &3
I-401	P&ID - CLARIFIERS 1&2- RAS
I-402	P&ID - CLARIFIERS 3&4- RAS
I-403	P&ID - CLARIFIERS 5&6- RAS
I-501	P&ID - TERTIARY FILTERS
I-601	P&ID - CHLORINE CONTACT CHAMBERS
I-701	P&ID - SLUDGE PUMPING
I-702	P&ID - BELT FILTER PRESSES
I-703	P&ID - SLUDGE UNLOADING
I-801	P&ID - CHEMICAL FEED SYSTEMS
I-802	P&ID - BFP POLYMER FEED
I-901	P&ID - INSTRUMENT DETAILS
I-902	P&ID - INSTRUMENT SCHEDULE
CIVIL	
C-101	PROCESS PIPING SITE PLAN - KEY
C-121	PROCESS PIPING SITE PLAN - AREA 1
C-122	PROCESS PIPING SITE PLAN - AREA 2
C-123	PROCESS PIPING SITE PLAN - AREA 3
C-124	PROCESS PIPING SITE PLAN - AREA 4
C-125	ENLARGED PLAN INFLUENT SEWER MODIFICATIONS
C-126	CIVIL SITE PLAN AND PROFILE
C-127	CIVIL SITE PLAN AND PROFILE
C-501	STORM WATER POLLUTION PREVENTION PLAN NOTES & ACTIVITY SCHEDULE
C-502	STORM WATER POLLUTION PREVENTION PLAN CHECKLIST
C-503	EXISTING SOIL DELINEATIONS & PROPERTIES

C-504	STORM WATER POLLUTION PREVENTION PLAN SAMPLING METHODS
C-505	STORM WATER PREVENTION PLAN SITE LOCATION & SAMPLING ANALYTICAL METHODS
C-506	STORM WATER POLLUTION PREVENTION PLAN PHASE 1
C-507	STORM WATER POLLUTION PREVENTION PLAN PHASE 2
C-508	STORM WATER POLLUTION PREVENTION PLAN PHASE 3
C-509	EROSION AND SEDIMENT CONTROL DETAILS
C-510	EROSION AND SEDIMENT CONTROL DETAILS
C-901	CIVIL/SITE DETAILS
C-902	CIVIL/SITE DETAILS
C-903	CIVIL/SITE DETAILS
DEMOLITION	
DD001	DEMO SITE PLAN - KEY
DD101	HEADWORKS UPPER AND LOWER LEVEL DEMOLITION PLAN
DD102	HEADWORKS DEMOLITION SECTION
DD111	MCC BUILDING DEMOLITION PLAN & SECTION
DD211	PRE-AERATION TANK LOWER LEVEL DEMOLITION PLAN
DD212	PRE-AERATION TANK UPPER LEVEL DEMOLITION PLAN
DD213	PRE-AERATION TANK DEMOLITION SECTIONS
DD601	CHLORINE CONTACT CHAMBER DEMO - KEY
DD611	CHLORINE CONTACT CHAMBER DEMO PLAN & SECTIONS
DD612	CHLORINE CONTACT CHAMBER DEMO PLAN & SECTION
DD701	SLUDGE DEWATERING AREA DEMOLITION PLAN
STRUCTURAL	
S-001	STRUCTURAL NOTES
S-311	PRIMARY SPLITTER BOX - PLAN VIEWS
S-312	PRIMARY SPLITTER BOX - SECTIONS
S-501	FILTER - LOWER PLAN
S-502	FILTER - UPPER PLAN
S-503	FILTER CANOPY ROOF FRAMING PLAN
S-504	FILTER - SECTIONS
S-505	FILTER - SECTIONS
S-911	STRUCTURAL STANDARD DETAILS

ARCHITECTURAL	
A0.01	GENERAL NOTES
A0.02	ACCESSIBILITY INFORMATION
A0.03	PARTITION TYPES - INTERIOR
A0.04	FIRESTOPPING – THRU PENETRATION SYSTEMS
A0.05	FIRESTOPPING – THRU PENETRATION SYSTEMS
A0.06	LIFE SAFETY - CODE STUDY
A0.07	LIFE SAFETY PLAN FIRST FLOOR
A0.08	LIFE SAFETY PLAN SECOND FLOOR
A1.00	GROUND FLOOR DEMOLITION PLAN
A1.00	SECOND FLOOR DEMOLITION PLAN
A1.01	GROUND FLOOR PLAN
A1.02	SECOND FLOOR PLAN
A2.01	GROUND FLOOR REFLECTED CEILING PLAN
A2.02	SECOND FLOOR REFLECTED CEILING PLAN
A3.01	ROOF PLAN
A4.01	EXTERIOR ELEVATIONS
A4.02	EXTERIOR ELEVATIONS
A5.01	BUILDING SECTIONS
A5.02	BUILDING SECTIONS
A5.31	VERTICAL CIRCULATION
A5.32	VERTICAL CIRCULATION
A5.41	RAILING SCHEDULE & DETAILS
A6.01	DOOR SCHEDULE, LEGEND, & DETAILS
A6.02	WINDOW & DOOR DETAILS
A6.03	INTERIOR DETAILS
A7.01	MILLWORK DETAILS
A7.11	MILLWORK DETAILS
A8.01	FINISH LEGEND AND SCHEDULE
A8.02	GROUND FLOOR FINISH PLAN
A8.03	SECOND FLOOR FINISH PLAN
A-111	MCC BUILDING MODIFICATION PLAN & SECTION
A-301	MAIN SPLITTER UPPER LEVEL PLAN

A-302	MAIN SPLITTER SECTIONS
A-501	FILTER - HANDRAIL GRATING
A-502	FILTER - ENLARGED PLAN & SECTIONS
A-503	FILTER - CANOPY ROOF PLAN
A-504	FILTER - EXTERIOR ELEVATIONS
PLUMBING	
P-101	PLUMBING PLAN - GROUND FLOOR - BELOW SLAB
P-102	PLUMBING GROUND FLOOR PLAN
P-103	PLUMBING - SECOND FLOOR PLAN
P-201	PLUMBING - SCHEDULE, NOTES, LEGEND & DETAILS
MECHANICAL	
M-101	GROUND FLOOR PLAN
M-102	FIRST FLOOR PLAN
M-103	MCC BUILDING PLAN
M-201	GROUND FLOOR PLAN
M-202	FIRST FLOOR PLAN
M-301	HVAC DETAILS
M-401	HVAC SCHEDULES, NOTES AND LEGEND
PROCESS	
D-001	PROCESS SITE PLAN - KEY
D-101	HEADWORKS UPPER & LOWER LEVEL PLAN
D-102	HEADWORKS SECTION
D-103	HEADWORKS SECTIONS
D-301	MAIN SPLITTER LOWER LEVEL PLAN
D-302	MAIN SPLITTER UPPER LEVEL PLAN
D-303	MAIN SPLITTER SECTIONS
D-311	RAS MODIFICATIONS PLAN & SECTION
D-401	CLARIFIER PLAN BOX B
D-402	CLARIFIER PLAN BOX C
D-403	CLARIFIER PLAN BOX D
D-410	CLARIFIER PLAN
D-411	CLARIFIER SECTIONS
D-501	FILTER - LOWER PLAN
D-502	FILTER - UPPER PLAN
D-503	FILTER - SECTIONS

D-504	FILTER - SECTIONS
D-505	FILTER - SECTIONS
D-601	CHLORINE CONTACT TANK MODIFICATIONS
D-702	MODIFICATIONS TO HEADHOUSE NO. 1
D-710	SOLIDS PROCESSING AREA KEY PLAN
D-711	SLUDGE OFFLOADING AREA
D-712	SLUDGE OFFLOADING AREA – SECTIONS
D-713	SLUDGE OFFLOADING AREA - SECTIONS
D-714	POLYMER SYSTEM AND SLUDGE FEED PIPING
D-801	ODOR TREATMENT SYSTEM PLAN & DETAILS
D-901	PIPE PENETRATIONNS DETAIL
D-902	PROCESS PIPE SUPPORT DETAILS
D-903	PROCESS PIPE SUPPORT DETAILS
D-904	PROCESS PIPE STRUCTURAL ATTACHMENTS
D-905	GATE SCHEDULE & DETAILS
D-906	PROCESS DETAILS
D-910	VALVE SCHEDULE - 1
ELECTRICAL	
E-001	LEGEND SHEET
E-002	DETAIL SHEETS
E-003	LIGHTING FIXTURE SCHEDULE
E-100	OVERALL SITE PLAN
E-200	HEADWORKS CONTROL PARTIAL SITE PLAN - ELECTRICAL
E-201	SCREEN UPPER & LOWER LEVEL PLANS - ELECTRICAL
E-202	ODOR CONTROL SYSTEM - ELECTRICAL
E-203	MAIN FLOW SPLITTER BOX - ELECTRICAL
E-204	HEADWORKS CONTROL & SCADA RISER
E-205	RAW SEWAGE PUMP STATION ONE - LINE DIAGRAM
E-300	DAF BUILDING PARTIAL SITE PLAN ELECTRICAL
E-301	DAF BUILDING - LOWER LEVEL LIGHTING PLAN
E-302	DAF BUILDING - UPPER LEVEL LIGHTING PLAN
E-303	DAF BUILDING - LOWER LEVEL POWER PLAN
E-304	DAF BUILDING - UPPER LEVEL POWER PLAN
E-305	DAF BUILDING - MECHANICAL EQUIPMENT SCHEDULE
E-306	DAF BUILDING ONE-LINE DIAGRAM

E-400	DEWATERING BUILDING SOLIDS HANDLING PLAN - ELECTRICAL
E-401	DEWATERING BUILDING POLYMER SYSTEM PLAN - ELECTRICAL
E-402	DEWATERING BUILDING CONTROL AND SCADA RISER
E-403	DEWATERING BUILDING ONE-LINE DIAGRAM
E-404	DEWATERING BUILDING ONE-LINE DIAGRAM
E-501	DISK FILTERS – ELECTRICAL
E-601	RAS BUILDINGS ELECTRICAL PLANS
E-602	RAS FLOW CONTROL LCP-4010 SCADA RISER
E-603	RAS FLOW CONTROL LCP-4020 SCADA RISER

1.4 CONTRACT TECHNICAL SPECIFICATIONS

SECTION NO.	TITLE
01 10 00	Summary
01 21 00	Allowances
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
01 29 00A	Contractor Progress Lien Waiver
01 29 00B	Subcontractor Lien Waiver
01 32 00	Construction Progress Documentation
01 33 00	Submittal procedures
01 40 00	Quality Requirements
01 50 00	Temporary Facilities and Controls
01 60 00	Product Requirements
01 70 00	Execution and Closeout Requirements
01 78 23	Operation and Maintenance Data
01 78 39	Project Record Documents
01 79 00	Demonstration and Training
01 81 00	Geotechnical Data
02 41 16	Structure Demolition
02 41 19	Selective Demolition
03 20 00	Anchorage in Concrete
03 30 00	Cast-In-Place Concrete
03 41 00	Precast Structural Concrete
03 60 00	Grouting
04 00 10	Unit Masonry Assembly
05 40 00	Aluminum Handrail
05 50 00	Metal Fabrications
05 51 19	Metal Grating Stairs
05 52 13	Pipe and Tube Railings
05 53 13	Bar Gratings
05 60 00	Aluminum Hatches
06 10 53	Miscellaneous Rough Carpentry

07 21 00	Thermal Insulation
07 26 00	Vapor Retarders
07 54 23	Thermoplastic-Polyolefin Roofing
07 62 00	Sheet Metal Flashing and Trim
07 84 00	Firestopping
07 92 00	Joint Sealants
08 11 13	Hollow Metal Doors and Frames
08 16 13	Fiberglass Reinforced Polymer (FRP) Doors and Frames
08 31 13	Access Doors and Frames
08 33 23	Overhead Coiling Doors
08 71 00	Door Hardware
08 80 00	Glazing
09 21 16	Gypsum Board Assemblies
09 30 00	Tiling
09 51 13	Acoustical Panel Ceilings
09 68 00	Carpeting
09 91 00	Painting
09 96 00	High-Performance Coatings
10 14 00	Signage
10 21 13	Toilet Compartments
10 22 26	Operable Partitions
10 28 13	Toilet Accessories
10 44 00	Fire Protection Specialties
10 44 16	Fire Extinguishers
13 31 22	Pre-Engineered Metal Building Systems
22 00 00	General Plumbing Provisions
22 05 00	Common Work Results for Plumbing
22 05 19	Meters and Gauges for Plumbing Piping
22 05 23	General Duty Valves for Plumbing Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 33	Het Tracing for Plumbing Piping
22 07 00	Plumbing Insulation
22 11 19	Plumbing Specialties
22 11 23	Water Distribution Pumps
22 13 16	Drainage and Vent Piping
22 33 00	Electric Water Heaters
22 40 00	Plumbing Fixtures
23 00 00	General HVAC Provisions
23 05 00	Common Work Results for HVAC
23 05 29	Hangers and Supports for HVAC Piping and Equipment
23 05 93	Testing Adjusting and Balancing
23 07 00	HVAC Insulation
23 09 00	Control System Equipment
23 09 93	Sequence of Operation
23 23 00	Refrigerant Piping and Condensate Drains
23 31 13	Metal Ductwork
23 33 00	Duct Accessories
23 34 23	Power and Gravity Ventilators
23 37 13	Diffusers, Registers, Grilles and Louvers

23 40 00	Bipolar Ionization Air Purification Systems
23 74 32	Packaged Dedicated Outside Air Units
23 81 26	Split System Heat Pumps and Air Conditioners
23 81 27	Variable Refrigerant Flow Zoning Heat Pumps
23 82 39	Unit Heaters
25 50 00	Controls and Systems Integration
25 50 30	SCADA System
26 05 00	Basic Electrical Requirements
26 05 19	Wires and Cables
26 05 26	Secondary Grounding
26 05 29	Supporting Devices
26 05 33	Raceways
26 05 33.01	Boxes
26 05 33.02	Electrical Connections for Equipment
26 05 53	Electrical Identification
26 22 00	Transformers
26 24 16	Panelboards
26 24 19	Motor Control Centers
26 27 26	Wiring Devices
26 28 16	Circuit and Motor Disconnects
26 29 13	Motor Controllers
26 32 13	Engine Driven Emergency Power Supply System
26 65 00	Electrical Equipment Acceptance Testing
27 05 26	Grounding and Bonding for Communication Systems
27 05 28	Pathways for Communications Systems
27 05 28.29	Hangers and Supports for Communications Systems
27 11 00	Communications Equipment Room Fittings
27 13 23	Communications Optical Fiber Backbone Cabling
27 15 13	Communications Copper Horizontal Cabling
27 15 23	Communications Optical Fiber Horizontal Cabling
28 31 11.01	Fire Alarm System
31 05 16	Aggregates for Earthwork
31 10 00	Site Clearing
31 20 00	Earth Moving
31 23 19	Dewatering
31 25 00	Erosion and Sedimentation Controls
31 50 00	Excavation Support and Protection
32 12 16	Asphalt Paving
32 13 13	Concrete Paving
32 13 73	Concrete Paving Joint Sealants
32 31 13	Chain Link Fences and Gates
32 91 13	Soil Preparation
32 92 00	Turf and Grasses
33 01 30.13	Sewer Manhole Testing
33 01 30.62	Manhole Grout Sealing
33 05 13	Manhole and Structures
33 05 16.13	Precast Concrete Utility Structures

33 31 00	Sanitary Utility Sewerage Piping
40 05 06	Couplings, Adapters, and Specials for Process Piping
40 05 07	Hangers and Supports for Process Piping
40 05 13	Common Requirements for Process Piping
40 05 19	Ductile Iron Process Pipe
40 05 51	Common Requirements for Process Valves
40 05 53	Identification for Process Piping
40 05 57	Actuators for Process Valves and Gates
40 05 59	Aluminum Slide Gates
40 05 62	Plug Valves
40 05 63	Ball Valves
40 05 64	Butterfly Valves
40 05 65.23	Swing and Disk Check Valves
40 05 67.36	Pressure-Regulating Valves
40 05 78	Combination Air Valves for Wastewater Service
40 41 13	Process Piping Electrical Resistance Heat Tracing
40 42 13	Process Piping Insulation
40 70 23	Process Control Narratives
40 71 13	Electromagnetic Flow Measuring System
40 72 24	Radar Levels
40 72 76	Level Switches
40 72 78	Optical Rotary Shaft Encoders
40 73 13	Pressure and Differential Pressure Gauges
40 73 26	Gauge-Pressure Transmitters
40 73 63	Diaphragm Seals
40 73 64	Annular Seals
41 13 12	Screw Bulk Material Conveyors
41 13 13	Live Bottom Sludge Bin
44 31 17	Chemical Media Odor Treatment System
44 31 21	Biofilter Odor Treatment System
44 33 11	Odor Control Covers
46 05 53	Identification for Water and Wastewater Equipment
46 21 13	Chain-and-Rake Bar Screen
46 21 73	Screenings Washing and Compacting Equipment
46 33 33	Polymer Blending and Feed Equipment
46 43 23	Energy Dissipating Feed Wells
46 43 81	Fiberglass Reinforced Plastic Density Baffle Curtains
46 61 23	Disc/Disk Cloth Tertiary Filtration
APPENDIX A	SCADA Allowance Scope of Supply
APPENDIX B	Cloth Disc Filter Scope of Supply

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.

1.3 DEFINITIONS

- A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

- A. Purchase products and systems selected by Engineer from the designated supplier.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Engineer under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Engineer under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Engineer, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump Sum Allowance: Include the sum of \$15,000 for purchase of owner-requested spare parts for project mechanical Equipment. This allowance is in addition to the spare parts included in the project which are listed in each equipment specification section.
- B. Allowance No. 2: Lump-Sum Allowance: Include the sum of \$446,500.00 for instrumentation and SCADA integration associated with the installation of headworks improvements, Main Flow Splitter, RAS flow control, filtration, and chemical feed systems. The scope of supply for this allowance can be found in the Appendix.
 - 1. This allowance shall include integrators field devices and SCADA integration including upgrade of existing equipment.
 - 2. The Suppliers scope of scope of supply for this allowance can be found in Appendix A.
- C. Allowance No. 3: Lump-Sum Allowance: Include the sum of \$1,250,000.00 for Cloth Disc Filter Equipment. The scope of supply for this allowance can be found in Appendix B

END OF SECTION 01 21 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Division 1 – General Requirements

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Engineer.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Proposal Request Form: Use form acceptable to the Engineer.

1.5 CHANGE ORDER PROCEDURES

- A. Change Order Procedures shall conform to the requirements of the General Conditions.
- B. A change in the project work that is consistent with the objective of the project and outside the scope of the project requires the execution and approval of a Change Order.
- C. On Owner's approval of a Work Changes Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form included in the bid documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than 14 days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Sub schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values coordinated with each phase of payment.

4. Sub schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub schedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section where a submittal is required.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of Contract Documents used (EJCDC, AIA, etc.).
 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - a. Include separate line items under contractor and principal subcontracts for Project closeout requirements in an amount totaling no less than 2.5% of the Contract Sum and subcontract amount.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 MEASUREMENT OF QUANTITIES

- A. 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.
- B. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- C. Measurement by Area: Measured by square dimension using mean length and width or radius.
- D. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- E. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.6 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by engineer and contractor and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Engineer by the 25th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

1. Submit draft copy of Application for Payment five business days prior to due date for review by Engineer.
- D. Application for Payment Forms: Use form consistent with Contract Documents (EJCDC, AIA, etc.) for Applications for Payment.
- E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.
- F. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- G. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- H. Transmittal:
 1. Deliverable:
 - a. Hard Copy: Submit three (3) signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - b. Digital: Submit one (1) signed and notarized copy of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 2. Contractor's Affidavit of Payment to Subcontractors
 - a. Shall be submitted with each Application for Payment.
 3. Contractor Progress Lien Waivers – Specification Section 012900A

- a. Shall be submitted with each Application for Payment after No. 1.
 4. Subcontractor/Supplier Lien Waivers – Specification Section 012900B
 - a. Shall be submitted with each Application for Payment after No. 1.
 5. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building and other local/state permits.
 7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 8. Report of preconstruction conference.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
 11. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. "Contractor's Affidavit of Payment of Debts and Claims."
 5. "Contractor's Affidavit of Release of Liens."
 6. "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

CONTRACTOR'S UNCONDITIONAL LIEN WAIVER UPON PROGRESS PAYMENT

The undersigned hereby acknowledge that the amount of

was received from

The Owner

as Progress Payment for the following goods and/or services:

performed at the property described as:

The undersigned hereby waives the right to assert a lien and release any lien against the owner to this extent only. This lien waiver does not affect the right of the undersigned to recover payment for any other goods or services supplied before or after this release date not compensated by the progress payment or any rights which the undersigned may have by contract.

Title and Name of Claimant

Company Details

Signature

Date

SUBCONTRACTOR'S UNCONDITIONAL LIEN WAIVER UPON PROGRESS PAYMENT

The undersigned hereby acknowledges that the amount of

was received from

as Progress Payment for the following goods and/or services:

for the following project:

(Project Name)

(Owner)

performed at the property described as:

through the following date:

The undersigned hereby waives the right to assert a lien and release any lien against the owner to this extent only. This lien waiver does not affect the right of the undersigned to recover payment for any other goods or services supplied before or after this release date not compensated by the progress payment or any rights which the undersigned may have by contract.

Title and Name of Claimant

(Company Name)

(Address)

Signature

Date

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Weekly construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.
 - 8. Preconstruction photographs.
 - 9. Periodic construction photographs.
 - 10. Final completion construction photographs.
 - 11. Preconstruction video recordings.
 - 12. Periodic construction video recordings.
 - 13. Web-based construction photographic documentation.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.
 - 3. Section 01 70 00 "Execution and Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 - 4. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Startup construction schedule.

- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Reports: Submit, at minimum, monthly intervals.
- E. Material Location Reports: Submit at monthly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.
- G. Special Reports: Submit at time of unusual event.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each process or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 2. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 3. Startup and Testing Time: Include no fewer than 30 for startup and testing.
 - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.

- e. Use of premises restrictions.
 - f. Environmental control.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10% percent increments within time bar.

2.3 REPORTS

- A. Monthly Construction Reports: Prepare a Monthly construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Emergency procedures.
 - 12. Orders and requests of authorities having jurisdiction.
 - 13. Change Orders received and implemented.
 - 14. Work Directives received and implemented.
 - 15. Services connected and disconnected.
 - 16. Equipment or system tests and startups.
 - 17. Partial completions and occupancies.
 - 18. Substantial Completions authorized.

- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within two day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two days before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

3.2 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
1. Date and Time: Include date and time in file name for each image.
 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
1. Flag construction limits before taking construction photographs.
 2. Take photographs to show existing conditions adjacent to property before starting the Work.
 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take photographs at necessary intervals with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Engineer-Directed Construction Photographs: From time to time, Engineer will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- F. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as project record documents. Retain subparagraph below if date stamp is not required.
1. Do not include date stamp.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled date of fabrication.
- B. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.
1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and record documents.
 - a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit and CAD files.
- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form.
 - a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Engineer.
 - 6) Name of Construction Manager.
 - 7) Name of Contractor.
 - 8) Name of firm or entity that prepared submittal.
 - 9) Names of subcontractor, manufacturer, and supplier.
 - 10) Category and type of submittal.
 - 11) Submittal purpose and description.
 - 12) Specification Section number and title.
 - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 14) Drawing number and detail references, as appropriate.
 - 15) Indication of full or partial submittal.
 - 16) Transmittal number
 - 17) Submittal and transmittal distribution record.
 - 18) Remarks.
 - 19) Signature of transmitter.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01. A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.

- g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
- 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- G. Options: Identify options requiring selection by Engineer.
- H. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.5 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Submit electronic submittals via email as PDF electronic files.
 - a. Engineer will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Action Submittals: Submit one paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
 3. Informational Submittals: Submit one paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
 4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:

- a. PDF electronic file.
 - b. One paper copies of Product Data unless otherwise indicated. Engineer will not return paper copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Engineer's digital data drawing files is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. One opaque (bond) copies of each submittal.
 - c. Shop Drawings Shall bear the Contractor's Stamp
 4. Do not use Engineer's Drawings for shop or erection purposes.
 5. Submitted to Engineer for review and conformance with information given in specifications and design concept expressed in contract documents. Review of shop drawings by Engineer shall not relieve Contractor of its responsibility for accuracy of shop drawings nor for furnishing of all materials and equipment required by the contract even though such items may not be indicated on shop drawings reviewed by Engineer.
 6. No review will be given to partial submittals of shop drawings for items which interconnect and/or are interdependent. It is the Contractor's responsibility to assemble shop drawings for all such interconnecting and/or interdependent items, check them and then make one submittal to Engineer.
 7. Schedule of Submittals: Within 30 days of Contract award and prior to any shop drawing submittal, Contractor shall submit a schedule showing the estimated submittal date and desired acceptance date for each shop drawing anticipated. Time lost due to unacceptable submittals shall be the Contractor's responsibility.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.

- b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
- 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
- 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit 1 set of samples to the Engineer and Owner for review.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 70 00 "Execution and Closeout Procedures."

- J. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- K. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for product Data. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.

7. Limitations of use.

- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents. Submit any reports manufacturer's representatives make while visiting for equipment installation. These reports shall be submitted in duplicate 30 days of site visit to the Engineer.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

1.6 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.7 Test Reports

- A. Submit for Engineer's knowledge as contract administrator or for the OWNER.
- B. Submit test reports for information and assessing conformance with information given in specifications 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 the Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 70 00 "Execution and Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

- A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Acceptable submittals will be marked "No Exceptions Taken." A minimum of three copies will be retained by the Engineer for Engineer's and Owner's use and remaining copies will be returned to Contractor.
- D. Submittals requiring minor corrections before the product is acceptable will be marked "Furnish as Corrected." Contractor may order, fabricate, and ship items included in submittals, provided the indicated corrections are made.
- E. Submittals marked "Revise and Resubmit" must be revised to reflect required changes and the initial review procedure repeated.

- F. The “Rejected” notation is used to indicate products not acceptable. Upon return of a submittal so marked, Contractor shall repeat the initial review procedure utilizing acceptable products.
- G. Only two copies of items marked “Revise and Resubmit” and “Rejected” will be reviewed and marked. One copy will be retained by Engineer and the other copy with all remaining unmarked copies will be returned to Contractor for resubmittal.
- H. No Work or products shall be installed without a drawing or submittal bearing the “No Exceptions Taken” or “Furnish as Corrected” notation. Contractor shall maintain at the job site a complete set of shop drawings bearing Engineer’s stamp.
- I. Substitutions: In the event Contractor obtains Engineer’s acceptance for use of products other than those listed first in Contract Documents, Contractor shall, at Contractor’s own expense and using methods accepted by Engineer, make any changes to structures, piping and electrical work necessary to accommodate these products.
- J. Use of “No Exceptions Taken” or “Furnish as Corrected” notation on shop drawings or other submittals is general and shall not relieve Contractor of the responsibility of furnishing products of proper dimension, size, quality, quantity, materials, all performance characteristics, and to efficiently perform requirements and intent of Contract Documents. Engineer’s review shall not relieve Contractor of the responsibility of errors of any kind on shop drawings. Review is intended only to assure conformance with design concept of the project and compliance with information given in Contract Documents.
- K. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- L. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- M. Submittals not required by the Contract Documents may be returned by the Engineer without action.

3.3 SUBMITTAL CHECKLIST

- A. This checklist is not necessarily complete. Contractor is responsible to submit all items and materials as specified in each section.

Section	Submittal	Date Received by GMC	Accepted Submittal Returned to Owner/Contractor	Submittal Rejected & Returned	Comments
03 20 00 Anchorage in Concrete					
	Product Data				

03 30 00- Cast-In-Place Concrete					
	Concrete Mix Design				
03 41 00- Precast Structural Concrete					
	Product Data				
	Design Mixtures				
03 60 00 - Grouting					
	Product Data				
	Manufacturer's Certificate and Instructions				
04 00 10 – Unit Masonry Assemblies					
	Color Samples				
	Product Data				
05 40 00 – Aluminum Handrail					
	Shop Drawings				
	Engineering Calculations				
05 50 00 – Metal Fabrications					
	Shop Drawings				
	Samples per Specifications				
05 51 19 – Metal Grating Stairs					
	Shop Drawings				
	Design Calculations				
	Grout Product Data				
05 52 13 – Pipe and Tubing Railings					
	Manufacturer's Information				
	Shop Drawings				
05 53 13 – Bar Gratings					

	Product Data				
	Shop Drawings				

	Shop Drawings				
	Published Load Tables				
05 60 00 – Aluminum Hatches					
	Construction Details, Individual components and profiles, and finishes				
06 10 53 – Miscellaneous Rough Carpentry					
	Product Data				
07 21 00 – Miscellaneous Rough Carpentry					
	Product Data				
	Product Test Reports				
	Research/Evaluation Reports				
07 26 00 – Vapors Retarders					
	Product Data				
07 54 23 – Thermoplastic- Polyolefin (TPO) Roofing					
	Product Data				
	Shop Drawings				
	Wind Uplift Resistance				
07 62 00 – Sheet Metal Flashing and Trim					
	Product Data				
	Shop Drawings				
	Samples as required				
07 84 00 – Firestopping					
	Product Data				
	Shop Drawings				
	Joint System Schedule				
	Qualification Data				

	Product Test Reports				
07 92 00 – Joint Sealants					
	Product Data				
08 11 13 – Hollow Metal Doors and Frames					
	Product Data				
	Shop Drawings				
	Door and Frame Schedule				
08 16 13 – Fiberglass Reinforced Plastic (FRP) Doors and Frames					
	Product Data				
	Shop Drawings				
	Door Hardware Schedule				
08 31 13 – Access Doors and Frames					
	Product Data				
	Shop Drawings				
08 33 23 – Overhead Coiling Doors					
	Shop Drawings				
	Samples for Initial Selection				
	Verification Samples				
	Certifications				
08 71 00 – Door Hardware					
	Product Data				
	Shop Drawings				
	Samples				
	Door Hardware Schedule				
	Keying Schedule				
08 80 00 – Glazing					

	Product Data				
	Framing Manufacturer's Approval				
	Samples				
	Glass Design Calculations				
	Maintenance Data				
09 21 16 – Gypsum Board Assemblies					
	Product Data				
	Product Certificates				
09 21 16 – Tiling					
	Product Data				
	Samples				
	Master Grade Certificate				
	Setting and Grout Materials				
	Maintenance Data				
09 51 13 – Acoustical Panel Ceilings					
	Product Data				
	Shop Drawings				
	Samples				
	Qualification Data				
	Product Test Reports				
09 51 13 – Carpeting					
	Product Data				
	Shop Drawings				
	Samples				
	Qualification Data				
	Test Reports				

	Maintenance Data				
09 96 00 – Painting					
	Product Data				
	Samples				
	Schedule				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Quality Assurance Submittals				
	Qualification Statements				
10 14 00 – Signage					
	Shop Drawings				
	Samples				
	Manufacturer's Installation In-structions				
10 21 13 – Toilet Compartments					
	Product Data				
	Samples				
	Maintenance Data				
10 22 26 – Operable Partitions					
	Product Data				
	Shop Drawings				
	Certification				
10 28 13 – Toilet Accessories					
	Product Data				
	Product Schedule				
	Setting Drawings				

	Maintenance Data				
10 44 00 – Fire Protection Specialties					
	Product Data				
	Shop Drawings				
	Finish Samples				
10 44 16 – Fire Extinguishers					
	Product Data				
	Product Schedule				
	Warranty				
	Operation and Maintenance Data				
13 31 22 – Pre-Engineered Metal Building System					
	Product Data				
	Shop Drawings				
	Professional Engineer's Certifica-				
22 00 00 – Common Work Results for Plumbing					
	Product Data				
	Samples				
	Shop Drawings				
	Coordination				
	Welder Certificates				
22 05 19 – Meters and Gages for Plumbing					
	Product Data				
	Product Certificates				
22 05 29 – Hangers and Supports for Plumbing Piping and Equipment					
	Product Data				

	Schedule				
	Welder Certificates				
	Shop Drawings				
22 05 33 – Heat Tracing for Plumbing Piping					
	Product Data				
	Shop Drawings				
	Field Quality Control				
	Operation and Maintenance Data				
	Warranty Data				
22 07 00 – Plumbing Insulation					
	Product Data				
22 11 16 – Water Distribution Piping					
	Water Samples and Test Results				
22 11 19 – Plumbing Specialties					
	Product Data				
	Reports				
	Maintenance Data				
22 11 23 – Water Distribution Pumps					
	Shop Drawings				
	Product Data				
	Wiring Diagrams				
	Product Certificates				
	Maintenance Data				
22 13 16 – Drainage and Vent Pipe					
	Test Results and Reports				

22 33 00 – Electric Water Heaters					
	Product Data				
	Shop Drawings				
	Setting Drawings				
	Wiring Diagrams				
	Product Certificates				
	Certificates of Shop Inspection				
	Field Quality Control Reports				
	Maintenance Data				
22 40 00 – Plumbing Fixtures					
	Product Data				
	Wiring Diagrams				
	Maintenance Data				
23 05 00 – Plumbing Fixtures					
	Product Data				
	Shop Drawings				
	Coordination Drawings				
	Welder Certificates				
23 05 29 – Hangers and Supports for HVAC Piping and Equipment					
	Product Data				
	Pipe Hanger and Support Schedule				
	Welder Certificates				
	Shop Drawings				
23 05 93 – Testing, Adjusting, and Balancing					
	Quality Assurance Submittals				

	Contract Document Examination Report				
	Strategies and Procedures Plan				
	Certified Testing Agency and Balancing Reports				
	Sample Report Forms				
	Warranty				
23 07 00 – Testing, Adjusting, and Balancing					
	Product Data				
23 09 93 – Sequence of Operation					
	Shop Drawings				
23 23 00 – Refrigerant Piping and Condensate Drains					
	Product Data				
	Shop Drawings				
	Qualification Data				
	Maintenance Data				
23 31 13 – Metal Ductwork					
	Product Data				
	Shop Drawings				
	Welding Certificates				
	Record Drawings				
	Maintenance Data				
23 33 00 – Duct Accessories					
	Product Data				
	Shop Drawings				
	Product Certifications				
	Maintenance Data				

23 34 23 – Power and Gravity Ventilators					
	Product Data				
	Shop Drawings				

Section	Submittal	Date Received by GMC	Accepted Submittal Returned to Owner/Cont ractor	Submittal Rejected & Returned	Comments
23 07 00 – Testing, Adjusting, and Balancing					
	Product Data				
23 09 93 – Sequence of Operation					
	Shop Drawings				
23 23 00 – Refrigerant Piping and Condensate Drains					
	Product Data				
	Shop Drawings				
	Qualification Data				
	Maintenance Data				
23 31 13 – Metal Ductwork					
	Product Data				
	Shop Drawings				
	Welding Certificates				
	Record Drawings				
	Maintenance Data				
23 33 00 – Duct Accessories					
	Product Data				
	Shop Drawings				
	Product Certifications				
	Maintenance Data				
23 34 23 – Power and Gravity Ventilators					
	Product Data				
	Shop Drawings				

Section	Submittal	Date Received by GMC	Accepted Submittal Returned to Owner/Contractor	Submittal Rejected & Returned	Comments
	Wiring Diagrams				
	Maintenance Data				
23 37 13 – Diffusers, Registers, Grilles and Louvers					
	Data Sheet				
	Performance Data				
	Schedule of Equipment				
	Assembly Drawing				
23 40 00 – Bipolar Ionization Air Purification Systems					
	Product Data				
	Operation and Maintenance Data				
23 74 32 – Packaged Dedicated Outside Air Units					
	Product Data				
	Shop Drawings				
	Commissioning Reports				
	Maintenance Data				
	Warranties				
23 81 26 – Split System Heat Pumps and Air Conditioners					
	Product Data				
	Shop Drawings				
	Maintenance Data				
	Warranties				
23 81 27 – Variable Refrigerant Flow Heat Pump Systems					

	Product Data				
	Shop Drawings				
	Commissioning Reports				
	Maintenance Data				
	Warranties				
23 82 39 – Unit Heaters					
	Product Data				
	Wiring Diagrams				
	Samples				
	Qualification Data				
	Field Test Reports				
25 50 00 – Controls and Systems Integration					
	Hardware Submittals				
	Test Outlines				
	Operations and Maintenance Data				
	Wiring Diagrams				
25 50 30 – Supervisory Control and Data Acquisition					
	Hardware Submittals				
	Software Submittals				
	Operation and Maintenance Manuals				
	Test Outlines and Procedures				
	Spares and Expendable Recommendations				
26 05 00 – Basic Electrical Requirements					

	Shop Drawings				
	Commissioning Reports				
	Maintenance Data				
	Warranties				
23 82 39 – Unit Heaters					
	Product Data				
	Wiring Diagrams				
	Samples				
	Qualification Data				
	Field Test Reports				
25 50 00 – Controls and Systems Integration					
	Hardware Submittals				
	Test Outlines				
	Operations and Maintenance Data				
	Wiring Diagrams				
25 50 30 – Supervisory Control and Data Acquisition					
	Hardware Submittals				
	Software Submittals				
	Operation and Maintenance Manuals				
	Test Outlines and Procedures				
	Spares and Expendable Recommendations				
26 05 00 – Basic Electrical Requirements					

	Shop Drawings				
	Record Documents				
26 05 19 – Wires And Cables					
	Product Data				
26 05 26 – Secondary Grounding					
	Product Data				
	Shop Drawings				
26 05 29 – Supporting Devices					
	Product Data				
	Shop Drawings				
26 05 33 – Raceways					
	Product Data				
26 05 33.01 – Boxes					
	Product Data				
	Shop Drawings				
26 05 33.02 – Electrical Connections for Equipment					
	Product Data				
26 22 00 – Transformers					
	Product Data				
	Shop Drawings				
26 24 16 – Panelboards					
	Product Data				
	Shop Drawings				
26 24 19 – Motor Control Centers					

	Product Data				
	Shop Drawings				
26 27 26 – Wiring Devices					
	Product Data				
26 28 16 – Circuit and Motor Disconnects					
	Product Data				
	Shop Drawings				
26 29 13 – Motor Controllers					
	Product Data				
	Shop Drawings				
26 32 13 – Engine Driven Emergency Power Supply System					
	Product Data				
	Factory Test Results				
	Shop Drawings				
26 65 00 – Electrical Equipment Acceptance Testing					
	Testing Plans and Outlines				
	Testing Reports				
27 05 26 – Grounding and Bonding for Communications System					
	Product Data				
	Shop Drawings				
27 05 28 – Pathways for Communication Systems					
	Product Data				
	Shop Drawings				
27 05 28.29 – Hangers and Supports for Communications System					

	Product Data				
	Shop Drawings				
	Delegated-Design Submittal				
27 11 00 – Communications Equipment Room Fittings					
	Product Data				
	Shop Drawings				
27 13 23 – Communications Optical Fiber Backbone Cabling					
	Product Data				
	Shop Drawings				
	Fiber Optic Testing Plan				
27 15 23 – Communications Optical Fiber Horizontal Cabling					
	Product Data				
	Shop Drawings				
	Fiber Optic Cabling Testing Plan				
28 31 11.01 – Fire Alarm System					
	Product Data				
	Wiring Diagrams				
	Isometric Detail				
	Maintenance Data				
	Manufacturer Certification				
31 05 16 – Aggregates for Earthwork					
	Samples (Geotechnical Lab)				
	Materials source				

	Manufacturer's Certificate				
31 23 19 – Dewatering					
	Shop Drawings				
31 25 00 – Erosion and Sedimentation Control					
	Product Data				
	Concrete Mix Data				
	Manufacturer's Certificate				
31 50 00 – Excavation Support and Protection					
	Product Data				
	Shop Drawings				
32 12 16 – Asphalt Paving					
	Product Data				
32 13 13 – Concrete Paving					
	Product Data				
	Design Mixtures				
32 13 73 – Concrete Paving Joint Sealants					
	Product Data				
	Samples for Verification				
	Paving joint Sealant Schedule				
32 31 13 – Chain Link Fences and Gates					
	Product Data				
	Shop Drawings				
	Samples for Selection				

	Samples for Verification				
	Delegated Design Submittals				
32 91 13 – Soil Preparation					
	Product Data				
32 92 00 – Turf and Grasses					
	Landscaper Qualifications				
	Certification of Grass Seed				
	Product Certificates				
	Pesticides and Herbicides				
33 01 30 – Sewer and Manhole Testing					
	Testing Procedures				
	List of testing equipment				
	Testing Sequence Schedule				
	Provisions for Flush Water Dis-				
	Certification of Test Gauges				
	Deflection Mandrel Drawings				
	Testing Safety Plan				
	Testing and Evaluation Reports				
33 01 30.62 – Manhole Grout Sealing					
	Product Data				
	Manufacturer's Certificate				
	Test and Evaluation Reports				
	Manufacturer's Instructions				

	Qualifications Statments				
33 05 13 – Manholes and Structures					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Test Reports				
	Design Data				
	Manufacturer Instructions				
	Filed Quality Control				
	Qualification Statements				
33 05 16.13 – Precast Concrete Utility Structures					
	Product Data				
	Shop Drawings				
	Submit Concrete Mix				
	Delegated Design Submittals				
	Manufacturer's Certificate				
	Delegated Design				
	Manufacturer's Instructions				
	Source Quality Control				
	Qualification Statements				
33 31 00 – Sanitary Utility Sewerage Piping					
	Product Data				
	Manufacturer's Certificate				

	Certified Mill Certificate				
	Manufacturer Instructions				
	Field Quality- Control				
	General Arrangement and Dimensional Draw-				
	Laboratory Approval				
40 05 07 – Hangers and Supports for Process Piping					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Welder's Certificate				
	Delegated Design Submittals				
	Manufacturer's Instructions				
	Qualification Statements				
40 05 13 – Common Requirements for Process Piping					
	Product Data				
	Shop Drawings				
	Manufacturer's Certified Test Reports				
	Material Certificates				
	Delegated Design Submittals				
	Qualification Statements				
40 05 19 – Ductile Iron Process Pipe					
	Product Data				

40 05 51 – Common Requirements for Process Valves

	Product Data				
	Shop Drawings				
	Valve Schedule				
	Manufacturer's Certificate				
	Certificate of Valves Larger than 12"				
	Delegated Design Submittals				
	Manufacturer's Instructions				
	Source Quality- Control Submittals				
	Field Quality-Control Submittals				
	Qualification Statements				

40 05 53 – Common Requirements for Process Valves

	Product Data				
	Shop Drawings				
	Samples				
	Manufacturer's Certificate				
	Qualifications Statement				

40 05 57 – Actuators for Process Valves and Gates

	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Source Quality Control Submittals				

Section	Submittal	Date Received by GMC	Accepted Submittal Returned to Owner/Contractor	Submittal Rejected & Returned	Comments
	Field Quality Control Submittals				
	Qualification Statements				
40 05 59 – Aluminum Slide Gates					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Source Quality Control Submittals				
	Field Quality Control Submittals				
	Manufacturer Reports				
	Qualification Statements				
40 05 62 – Plug Valves					
	Product Data				
	Shop Drawings				
40 05 63 – Ball Valves					
	Product Data				
	Shop Drawings				
40 05 64 – Butterfly Valves					
	Product Data				
	Shop Drawings				
40 05 65.23 – Swing and Disc Check Valves					
	Product Data				

	Shop Drawings				
40 05 67.36 – Pressure-Regulating Valves					
	Product Data				
	Shop Drawings				
40 05 78 – Combination Air Valves for Wastewater Service					
	Product Data				
	Shop Drawings				
40 41 13 – Combination Air Valves for Wastewater Service					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Field Quality-Control Submittals				
	Manufacturer Reports				
	Qualification Statement				
40 42 13 – Combination Air Valves for Wastewater Service					
	Product Data				
	Manufacturer's Instructions				
40 71 13 – Magnetic Flow Meters					
	Product Data				
	Shop Drawings				
40 72 24 – Radar Levels					
	Product Data				
40 05 67.36 – Pressure-Regulating Valves					
	Product Data				
	Shop Drawings				

40 05 78 – Combination Air Valves for Wastewater Service					
	Product Data				
	Shop Drawings				
40 41 13 – Process Piping					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Field Quality-Control Submittals				
	Manufacturer Reports				
	Qualification Statement				
40 42 13 – Process Piping Insulation					
	Product Data				
	Manufacturer's Instructions				
40 71 13 – Magnetic Flow Meters					
	Product Data				
	Shop Drawings				
40 72 24 – Radar Levels					
	Product Data				
40 72 26 – Level Switches					
40 72 78 – Optical Rotary Shaft Encoders					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Field Quality Control Submittals				

	Qualifications Statements				
40 73 13 – Pressure and Differential Pressure Gauges					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Source Quality Control Submittals				
	Field Quality Control Submittals				
40 73 26 – Gauge Pressure Transmitter					
	Product Data				
	Shop Drawings				
40 73 63 – Diaphragm Seals					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Source Quality Control Submittals				
	Field Quality Control Submittals				
	Qualifications Statement				
40 73 64 – Annular Pressure Seals					
	Shop Drawings				
	Manufacturer's Certificate				
	Source Quality Control Submittals				
	Field Quality Control Submittals				
41 13 12 – Shaftless Screw Conveyor					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				

	Manufacturer's Instructions				
	Filed Quality Control Submittals				
	Qualifications Statements				
41 13 13 – Live Bottom Sludge Bin					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Filed Quality Control Submittals				
	Qualification Statements				
41 31 17 – Chemical Media Odor Treatment Equipment					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer's Instructions				
	Source Quality Control Submittals				
	Field Quality Control Submittals				
	Manufacturer Reports				
	Qualification Statements				
41 31 21 – Odor Control Biofilter					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer Instructions				
	Source Quality Control				
	Field Quality Control				

	Manufacturer's Reports				
	Qualification Statements				
41 33 11 – Odor Control Covers					
	Product Data				
	Shop Drawings				
46 05 53 – Identification for Water and Wastewater Equipment					
	Product Data				
	Shop Drawings				
	Manufacturer's Installation				
	Manufacturer's Certificate				
46 21 13- Chain-and-Rake Bar Screens					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificates				
	Manufacturer Instructions				
	Field Quality Control Submittals				
	Qualifications Statements				
	Submit Manufacturer's Approval of Installer				
46 21 73- Screenings Washing and Compacting Equipment					
	Product Data				
	Shop Drawings				
	Manufacturer's Instructions				
	Field Quality Controls				
	Manufacturer's Reports				
	Qualification Statements				

46 33 33- Polymer Blending and Feed Equipment					
	Product Data				
	Shop Drawings				
	Manufacturer's Certificate				
	Manufacturer Instructions				
	Field Quality Control Submittals				
	Manufacturer Reports				
46 43 81- Fiberglass Reinforced Plastic Density Baffle Curtains					
	Shop Drawings				
	Manufacturer's Data				
	Certificates				
	Manufacturer's Instructions				
46 61 23 – Disc Cloth Tertiary Filtration					
	Product Data				
	Calculations of Filter Surface				
	Hydraulic Profiles				
	Shop Drawings				
	Maintenance Instructions				
	Installation Instructions				
	Wiring Diagrams				
	Parts List				
	Qualification Data				
	Sample Warranty				

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:

- 1. Quality control.
- 2. Testing and inspection services.
- 3. Manufacturers' field services.
- 4. Shop Testing.
- 5. Field Testing.

- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

- 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
- 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
- 3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Quality control.
 - 2. Testing and inspection services.
 - 3. Manufacturers' field services.
 - 4. Shop Testing.
 - 5. Field Testing.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 REFERENCES

- A. ASTM C 802 – Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials.
- B. ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- C. ASTM C 1093 – Practice for Accreditation of Testing Agencies for Masonry.
- D. ASTM D 3740 – Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

- E. ASTM D 4561 – Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials.
- F. ASTM E 329 – Specification for Agencies Engaged in Construction Inspection and/or Testing.
- G. ASTM E 543 – Practice for Agencies Performing Nondestructive Testing.
- H. ASTM E 548 – Guide for General Criteria Used for Evaluating Laboratory Competence.

1.4 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
 - 2. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.5 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will employ and pay for the services of a resident Project representative (RPR)
- B. Contractor shall employ and pay for the services of an independent testing laboratory to perform all specified services and testing not specifically identified to be provided by Owner related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests.
 - 1. Employment of the laboratory shall in no way relieve Contractor's obligations to perform the Work of the Contract
- C. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- D. Agency or laboratory may not approve or accept any portion of the Work.
- E. Agency or laboratory may not assume any duties of Contractor.
- F. Agency or laboratory has no authority to stop the Work.
- G. Laboratory: Authorized to operate in State in which project is located.
- H. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.
- I. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.6 ACCEPTABLE TESTING AGENCIES

- A. Goodwyn Mills & Cawood; Atlanta, GA
- B. Or Pre-Approved Equal

1.7 CONTRACTOR RESPONSIBILITIES

- A. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used requiring testing, along with proposed mix designs.
- B. Cooperate with laboratory personnel and provide access to the Work and to manufacturer's facilities.
- C. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested.
 - b. To obtain and handle samples at the site or at source of products to be tested.
 - c. To facilitate tests.
 - d. To provide storage and curing of test samples.

1.8 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

1.9 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Engineer.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Engineer.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.10 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. This plan shall include the name and qualifications of the Contractor's testing agency. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

1.11 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
 14. Provide interpretation of results upon Engineer request
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representatives making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.12 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- F. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor will appoint and employ services of an independent firm to perform testing. Contractor shall pay for testing services required by the specifications
 - b. The independent firm will perform tests and other services specified in individual specification sections and as required by the Owner.
 - c. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Owner.
 - d. Reports will be submitted by the independent firm to the Engineer and Contractor, 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.
 - f. F. Testing does not relieve Contractor to perform Work to contract requirements
 - g. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for re-testing will be made by the Contractor.
- A. Contractor must, Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full-time registered Engineer and responsible officer. Also submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the in-

spection.

3. Retain first subparagraph below to assure validity of agencies' reports.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 4. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
 5. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- G. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures." Reports shall be sent to the Engineer within 30 days of site visit. Report shall include any site decisions and or instructions given by the manufacturer's representative.
- H. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- I. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
 7. Test samples of mixes submitted by Contractor.
 8. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 9. Perform specified sampling and testing of products in accordance with specified standards.
 10. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 11. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
 12. Perform additional tests required by Engineer.

13. Attend preconstruction meetings and progress meetings as required by the Owner or Engineer.
- J. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
- K. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- L. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 70 00 "Execution and Closeout Requirements."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

3.3 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- B. Examine and verify specific conditions described in individual specification sections.
- C. Verify utility services are available, of the correct characteristics, and in the correct locations.

3.4 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 any new material or substance in contact or bond.

3.5 SCHEDULE OF TESTS

- A. This schedule of tests is not an exhaustive list and does not relieve the Contractor from performing adequate quality control measures.

Section	Test	Frequency		Performed By	Note
31 20 00 – Earthwork					
	Compaction				
	Unpaved	1 test per horizontal layer per 5,000 sf of fill area			

	Paved	1 test per horizontal layer per 2,000 sf of subgrade			
	Building Pad	1 test per horizontal layer per 2,000 sf of fill area			
	Curb & gutter	1 test per 300 lf			
	Proof Rolling	As necessary			
	Trench Backfill	1 test per every 150 lf of trench.			
31 05 16 – Aggregate Base Course					
	Base Density	1 test per 5,000 sf			
03 33 00 – Concrete					
	Mix Designs	1 per mix design			
	Compressive Strength	4 test cylinders for every pour larger than 5 cy and less than 25 cy and for each additional 50 cy after			
		2 cylinder broken at 7 days			
		2 cylinders broken at 28 days			
	Slump	1 test per each set of cylinders			
	Air Content	1 test per each set of cylinders			
	Temperature	1 test per each set of cylinders			
Other Tests – See Project Specifications for requirements and Details					

END OF SECTION 01 40 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to Engineer, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Sewer service use charges shall be by the Contractor utilizing portable facilities.
- C. Water Service: Water-service use charges for water used by all entities for construction operations shall be by the Contractor.
- D. Electric Power Service: Electric-power-service use charges for electricity used by all entities for construction operations shall be by the Contractor.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction (DHEC), whichever is more stringent.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Engineer and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot square tack and marker boards.
 3. Drinking water and private toilet.
 4. Coffee machine and supplies.
 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

- 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Heating and Cooling Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead or underground or as indicated.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.

- d. Contractor's emergency after-hours telephone number.
 - e. Engineer's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
2. Provide superintendent with cellular telephone for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Final Completion.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads.
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Provide temporary parking areas for construction personnel.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted. Subcontractors are not authorized to have signage.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

- a. Provide temporary construction signs as required by funding agencies.
 - b. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
 - G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017000 "Execution and Closeout Requirements."
 - H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - I. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 1. Do not load elevators beyond their rated weight capacity.
 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
 - J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
 - K. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
 - L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.
- 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with authorities having jurisdiction, and requirements specified in Section 312500 "Erosion and Sedimentation Controls."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 3. Insulate partitions to control noise transmission to occupied areas.
 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 5. Protect air-handling equipment.
 6. Provide walk-off mats at each entrance through temporary partition.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017000 "Execution and Closeout Requirements."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranty requirements shall conform with the General Conditions followed by Specification Section 01 10 00.

1.8 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

- B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless the Specifications clearly state approved equal is accepted.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with

requirements. Comparable products or substitutions for Contractor's convenience will be considered,

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Engineer's sample", provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution of Major Equipment Items and Products" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

1.9 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 5. Samples, if requested.
 6. The Contractor shall also include in the price bid the modifications necessary for the comparable product to be utilized. This includes but is not limited to, electrical and mechanical changes, engineering time to assess the changes, modifications to buildings, programmable controls and structural modifications.

PART 2 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Field engineering.
2. Closeout procedures.
3. Starting of systems.
4. Demonstration and instructions.
5. Testing, adjusting, and balancing.
6. Project record documents.
7. Operation and maintenance data.
8. Manual for materials and finishes.
9. Manual for equipment and systems.
10. Spare parts and maintenance products.
11. Product warranties and product bonds.
12. Examination.
13. Preparation.
14. Execution.
15. Cutting and patching.
16. Protecting installed construction.
17. Final cleaning.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

1.2 FIELD ENGINEERING

- A. Employ land surveyor registered in state of Georgia acceptable to Engineer.
- B. Locate protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.
- C. Control datum for survey is indicated on Drawings.
- D. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- E. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.
- F. Submit copy of certificate signed by land surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

- G. On completion of foundation walls and major Site improvements, prepare certified survey illustrating dimensions, locations, angles, and elevations of construction and site work
- H. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- I. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:

- 1. Submit operation and maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
- 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
- 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
- 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
- 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner at project site and store per Owner guidance.
- 6. Make final change-over of locks and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
- 7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
- 8. Perform final cleaning according to this Section and prior to final project assesment.

- B. Substantial Completion Inspection:

- 1. When Contractor considers Work to be substantially complete, submit to Engineer:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
- 2. Within seven days after receipt of request for Substantial Completion, Engineer will make inspection to determine whether Work or designated portion is substantially complete.
- 3. Should Engineer determine that Work is not substantially complete:
 - a. Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Engineer.

- c. Engineer will re-inspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer and Owner's inspection.
- 4. When Engineer finds that Work is substantially complete, Engineer will:
 - a. Prepare Certificate of Substantial Completion on EJCDC C-625 - Certificate of Substantial Completion accompanied by Contractor's list of items to be completed or corrected as verified and amended by Architect/Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
- 5. After Work is substantially complete, Contractor shall:
 - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
 - 1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.
 - d. Work is completed and ready for final inspection.
 - 2. Submittals: Submit following (Prior to final Application of Payment):
 - a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents. Two (2) duplicate notarized copies shall be provided. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts.
 - f. Contractor affidavit of release of liens.
 - g. Consent of surety to final payment.
 - 3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
 - 1. Within seven days after receipt of request for final inspection, Owner and Engineer will make inspection to determine whether Work or designated portion is complete.
 - 2. Should Engineer consider Work to be incomplete or defective:

- a. Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
- b. Contractor shall remedy stated deficiencies and send second written request to Work is complete.
- c. Engineer will re-inspect Work.
- d. Redo and Inspection of Deficient Work: Repeated until Work passes inspection.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Engineer and owner seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly, as well as a certificate/field report from the manufacturer from his inspection of the installation.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel as equipment becomes available for use and not later than 14 days prior to date of Substantial Completion.
- B. Demonstrate Project equipment and instruct in classroom environment located at the facility. Class shall be instructed by qualified manufacturer's representative who is knowledgeable about the Project.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at designated location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.6 TESTING, ADJUSTING, AND BALANCING

- A. Contractor with Engineer approval will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services.
- B. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or noncompliance with requirements of Contract Documents.

1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, product data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 - 5. Identify and locate existing buried or concealed items encountered during Project.
 - 6. Measured depths of foundations in relation to finish floor datum.
 - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 9. Field changes of dimension and detail.

10. Details not on original Drawings.

- G. Submit marked-up paper copy documents to Architect/Engineer with claim for final Application for Payment.

1.8 OPERATION AND MAINTENANCE DATA

- A. See Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manuals.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that 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 that utility services are available with correct characteristics and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- 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.

3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.
- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
 - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
 - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
 - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Architect/Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Architect/Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

3.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installers 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 nonconforming Work.
 4. Remove samples of installed Work for testing.
 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

3.6 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
1. Employ experienced personnel or professional cleaning firm.

- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces, and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Clean filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION 01 70 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file Shall be provided. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.

- a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 2. Two paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Format: Submit operations and maintenance manuals in the following format:
 3. Submit data on 8-1/2 x 11-inch text pages, bound in appropriately sized D ring binders with durable plastic covers. Use white 24 pound paper
 4. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of project Indicate subject matter of binder when multiple binders are required
 5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
 6. Drawings shall be printed on 11" x 17" and folded to size of text pages.
 7. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified in three parts as follows:
 8. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 9. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 10. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Originals of warranties and bonds
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.
1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training. Submit two (2) sets of revised final volumes, within 10 days after final walk through.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Engineer.
 8. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.

9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 1. Binders: Heavy-duty, three-ring, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch and 11 x 17 paper (Z folded); with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below. Provide Panelboard and circuit board diagrams, Sequence of controls, Controls diagram, Color coded wiring diagram.
 - 1. 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.

2. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 3. Include sequence of operation by controls manufacturer.
 4. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 5. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
 6. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
 7. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 8. Include test and balancing reports.
 9. Additional Requirements: As specified in individual product specification sections.
 10. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- F. Comply with Section 01 70 00 "Execution and Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 70 00 "Execution and Closeout Procedures" for general closeout procedures.
 - 2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Final Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and one set(s) of prints.
 - 3) Print each drawing, whether or not changes and additional information were recorded.
- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Contractor shall maintain a set of marked up prints on the job site for review prior to pay request approval.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Furnish demonstration and training instruction time as a subsidiary obligation of the price bid.

1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.

- f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Engineer with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 79 00

SECTION 01 81 00 – GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Report of explorations and tests of subsurface conditions at the site.

1.2 RELATED SECTION

- A. Section 31 20 00 – Earth Moving
- B. Section 31 23 19 – Dewatering
- C. Section 31 50 00 – Excavation Support and Protection

1.3 INVESTIGATION

- A. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the report titled “Geotechnical Engineering Report Proposed Academy Creek Improvements” issued by Whitaker Laboratory Inc. (GMC), dated 10/23/2019 GMC Project Number 10-23-19-5
- B. Bidders are urged to examine soils investigation data and to make their own investigation of the site before bidding. The information in the report provided is not a warranty of existing site conditions.
- C. Boring results and soil improvement recommendations are included in the plans.

1.4 INTERPRETATION

- A. Soil investigation data is provided only for information and the convenience of bidders.
- B. Owner and Engineer disclaim responsibility for interpretations of geotechnical data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, level, and extent of underground water.
- C. Bidders are urged to examine the GMC Geotechnical Report that addresses the purpose, basis, and warranties relevant to that report.
- D. Owner and Engineer disclaim all responsibility for the existence of other soil and subsurface investigations previously prepared for Owner, Engineer, or others. It is the sole responsibility of the Bidder to obtain other soil and subsurface investigations that may be available for interpretation, at no additional cost to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01 81 00



Geotechnical Engineering Report

Proposed Academy Creek WCPF Improvements

Newcastle Street

Brunswick, Georgia

October 23, 2019

Project No. 10-23-19-5

Prepared For:

**GMC Network
Birmingham, AL**

Prepared By:

**Whitaker Laboratory, Inc.
Savannah, Georgia**



WHITAKER LABORATORY, INC.

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October 23, 2019

GMC Network
2701 1st Avenue South
Suite 100
Birmingham, AL 35233

Attention: Mr. Kevin Wales, PE
Executive Vice President – Geotechnical & Construction Services
T: 205.879.4462
C: 205-365-6902
E: kevin.wales@gmcnetwork.com

Referencing: Report of Geotechnical Evaluation Services
Proposed Improvements to Academy Creek WCPF
Newcastle Street, Brunswick, Georgia
Project No. 10-23-19-4

Dear Mr. Wales:

As requested, WHITAKER LABORATORY, INC. has conducted a geotechnical investigation at the above referenced site. Authorization to perform this investigation was provided by your acceptance of our proposal dated October 4, 2019. Our findings and recommendations for design and construction are attached and it is important that you read the report in its entirety.

It is a pleasure to provide our services to you and we look forward to further opportunities to assist you on this and other projects.

Respectfully submitted,
WHITAKER LABORATORY, INC.



Jason H. Follo, P.E.
GA Registered Engineer
#31031



Blake L. Jones, P.E.
GA Registered Engineer
#44657

WHITAKER LABORATORY, INC.

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REPORT OF GEOTECHNICAL INVESTIGATION

Proposed Academy Creek WCPF Improvements

Newcastle Street

Brunswick, Georgia

I. INTRODUCTION / SCOPE

WHITAKER LABORATORY, INC. has completed this field investigation of the surface and subsurface conditions at this site. The preliminary conditions found, and how those conditions could affect the design and construction of foundations for the structures planned, form the basis for this report. Regardless of the thoroughness of any geotechnical investigation, there are limitations, and deviations from the conditions found in this investigation could be subsequently disclosed. We recommend that this report be provided to all parties involved in the planned development to include but not necessarily limited to the Owner, Architect, Design Engineers, General Contractor and sub-contractors. Unanticipated circumstances often arise during sitework, earthwork and foundation construction. Accordingly, we recommend that our firm be retained to provide the construction surveillance, inspection, and testing on the project, thereby being readily available to assist in the evaluation of any conditions encountered that differ from those anticipated.

We understand proposed improvements are planned for construction at Academy Creek WCPF in Brunswick, GA. Whitaker has not been provided with these planned improvements for this facility. Per your request, we performed a total of two cone penetration test (CPT) soundings and two dynamic cone penetration (DCP) test auger borings. Soundings and borings were advanced within the areas provided by you and extended to depths ranging from 4 ½ to 40 feet below the ground surface.

Please note that ground penetrating radar (GPR) was utilized to identify underground utilities within sounding & boring areas prior to performing the soundings & borings. In addition, GPR was performed within a designated area near the influent structure in an effort to map existing underground utilities in this area for your future reference. We have provided the GPR report in Appendix V of this report for your review and future reference.

As requested, a visual inspection of the top of the influent structure was performed by a professional engineer.

Please note that this evaluation only applies to the foundations for construction. This evaluation does not apply to any future improvements, which may be made to the site. In particular, if at any time should additional fill be placed, adjacent to or nearby the structures referenced in this report, additional geotechnical borings and a follow up geotechnical analysis will be required. Standard billing rates will apply for this work.

At any time, we will be glad to discuss the contents of this report. This includes insuring that you fully consider potential problems for design and construction procedures in respect to interpretations of the data.

II. SUBSURFACE CONDITIONS & SOIL CLASSIFICATIONS

The field exploration to determine the characteristics of the subsurface materials included a reconnaissance of the project site, the advancement of a DCP auger boring and the advancement of an electronic cone penetrometer.

Dynamic Cone Penetration testing (DCP) is done within hand augered holes. The DCP test is performed at regular intervals below the ground surface. DCP testing is performed with a hand held 15-pound hammer. The hammer falls 20-inches every blow. The hammer is attached to steel rods containing a conical driving tip that is 1.5-inches in diameter (ASTM STP-339).

The electric cone penetrometer is utilized to perform Cone Penetration Testing (CPT). An electric cone attached to the end of a series of rods is pushed into the ground at a constant rate and nearly continuous measurements are made of the resistance to penetration on the cone. Load cells (bonded strain gauges) build inside the electronic cone record end bearing, q_c , and friction sleeve stress, f_s as the cone is being pushed into the ground.

Both the Cone Penetration Test (CPT) and Dynamic cone penetrometer (DCP) test provide an indication of the relative consistency, density and in-situ strengths of the tested soils.

Soil samples from auger cuttings have been used for identification and visual classification. The subsurface stratification and the profile as presented in the boring logs, represent approximate boundary lines between the strata and materials encountered. These boundary lines are usually gradual and not clearly defined, and it is sometimes difficult to record changes in stratification precisely. It should be noted that underlying soil conditions can, and do, vary considerably within short lateral distances. It is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis.

Soil behavior types identified within CPT logs are generated from the data collected during the CPT test and are based upon the soil classification chart for standard electronic friction cone (adopted from Robertson and Campanella UBC - 1983). The chart can be viewed within Appendix IV of this report.

The approximate locations of DCP auger borings and CPT tests are shown on the attached BORING LOCATION PLAN. Our field crews based on landmarks and features available at the time of work have estimated the test locations in the field. If the precise test locations are critical, this can be determined by employing a land-surveying firm to plot the true locations. Such survey should be completed promptly and before any disturbance to the area has occurred. If desired, WHITAKER LABORATORY, INC. will be glad to coordinate surveying arrangements for an additional fee.

Below approximately 3 to 4 inches of organic topsoil, the subsurface soils on this site predominately consist of very loose to dense sands and silty sands (SP, SP-SM and SM) extending to the termination depths of the deeper soundings at 40 feet below the ground surface.

Please note that within DCP-1 and DCP-2 buried debris was encountered ranging in depth from 2 ½ to 4 ½ feet below the existing ground surface elevation.

Further, within CPT-2 very loose sands were encountered bracketing elevations 3 ½ to 6 feet below the existing ground surface elevation.

The above description of the subsurface profile should be considered a general description intended to highlight the major strata encountered. More detailed profiles can be observed within the attached logs. Please note that sounding & boring logs are only representative of their location. Stratification transitions should be expected to occur outside and between test locations.

III. SEISMIC SITE CLASSIFICATION AND COEFFICIENTS

Liquefaction Potential:

Whitaker Laboratory, Inc. performed a liquefaction analysis on the soils encountered within CPT sounding CPT-1. Liquefaction typically occurs when very loose to loose non-cohesive soils encountered below the groundwater table experience a significant loss of shear strength due to the increase in porewater pressure resulting from seismic vibrations.

The design earthquake utilized in our analysis (Charleston, SC earthquake with magnitude 7.3 and a 2% probability of exceedance in 50 years) yielded peak horizontal ground surface accelerations of 0.12g on this site. Based upon the design earthquake and characteristics of subsurface soils within CPT-1, the liquefaction analysis indicated that the encountered sand stratifications present below the groundwater table do not have potential to liquefy during the design seismic event. Therefore, liquefaction induced settlements should not be of concern in the design of planned structures to reside on this site.

Seismic Parameters:

This site is defined as a Site Class "D". The classification is determined by average soil properties in the top 100 feet of the soil profile, including standard penetration test N values, shear wave velocities, in-situ shear strengths and moisture contents, as specified by IBC 2012/15 & ASCE 7-10.

$$\begin{aligned}S_s &= 0.163 \\S_1 &= 0.078 \\S_{MS} &= 0.260 \\S_{M1} &= 0.187 \\S_{DS} &= 0.174 \\S_{D1} &= 0.125\end{aligned}$$

A summary report is attached in Appendix III of this report. If the size and/or design of this structure justifies additional investigation, a Site Specific Geotechnical Investigation and dynamic site response analysis shall be performed. Our firm has the ability to provide our clients such testing and evaluation, and we will be available to discuss the cost, and potential benefit, if any, of such if you desire.

IV. LATERAL EARTH LOADING RECOMMENDATIONS

Earth pressure coefficients should be selected by the designer based on the type of wall, whether the wall is braced or un-braced and other conditions. For "worst case" design conditions where positive drainage is not provided or is temporarily interrupted, the hydrostatic pressure will have to be added to the earth pressure on the wall. For this design groundwater should be assumed to reside at the ground surface.

Based upon the CPT testing performed, Whitaker Laboratory, Inc. is providing the following soil parameters for your use in the design and construction of the planned bulkhead wall:

CPT-1

Depth (ft, below ground surface)	SPT "N" Range (from CPT Logs)	Soil Classification (from CPT Logs)	Approximate Soil Unit Weight (pcf)		Internal Friction Angle (degrees)	Cohesion (psf)	Earth Pressure Coefficients	
			Sat	Submerged			Active Ka	Passive Kp
1 - 11	9 - 15	SP-SM, SM	115	52.6	30	0	0.33	3.0
11 - 17	11 - 21	SP-SM	115	52.6	30	0	0.33	3.0
17 - 25	20-27	SP	117	54.6	32	0	0.31	3.25
25 - 30	40 - 52	SP	119	56.6	34	0	0.28	3.5
30 - 40	20	SP-SM	115	52.6	30	0	0.33	3.0

CPT-2

Depth (ft, below ground surface)	SPT "N" Range (from CPT Logs)	Soil Classification (from CPT Logs)	Approximate Soil Unit Weight (pcf)		Internal Friction Angle (degrees)	Cohesion (psf)	Earth Pressure Coefficients	
			Sat	Submerged			Active Ka	Passive Kp
1 - 4	9 - 11	SP-SM, SM	115	52.6	30	0	0.33	3.0
4 - 6	4 - 6	SP-SM	112	49.6	28	0	0.36	2.7
6 - 15	10-28	SP, SP-SM	117	54.6	32	0	0.31	3.25
15 - 20	10 - 38	SP	117	54.6	32	0	0.31	3.25
20 - 28	20 - 67	SP	119	56.6	34	0	0.28	3.5

All backfill placed behind the wall should be placed in maximum 12-inch loose lift thicknesses with each lift compacted by conventional compaction equipment to 95% density in accordance with ASTM D-1557.

All of the backfill for this project should consist of a clean, free draining granular soil. The soil should be free of objectionable roots, clay lumps, organics and other debris. Soils classified as SW, SP or SM-SP with a maximum of 12% passing a #200 sieve will be acceptable.

Assuming all backfill consists of and is placed in accordance with the recommendations provided above, soil parameters provided in the below table should be used in the design of the wall corresponding to the backfill soil placed behind the wall:

Soil Classification For Backfill	Approximate Soil Unit Weight (pcf)		Internal Friction Angle (degrees)	Cohesion (psf)	Earth Pressure Coefficients	
	Sat	Submerge d			Active, Ka	Passive Kp
SP or SP-SM	115	52.6	30	0	0.33	3.0

V. SUBGRADE PREPARATION RECOMMENDATIONS

We will be pleased to discuss these recommendations with the owner and the site work contractor selected to do the work. We believe it will be beneficial to the project, for the owner and the contractor to have a clear understanding of our recommendations.

1. Prior to construction, all building areas, plus at least 10 feet on each side and all areas to be paved, should be stripped of all vegetation, topsoil and root systems. Site drainage during construction should be considered prior to this clearing and stripping. Preventing the ponding of storm water is of particular importance.
2. Topsoil, organics, root-mat and other surface materials will likely vary across the site. Individual test borings may not accurately reflect the presence of, or the thickness of such materials due to site variability and/or surfacing clearing to facilitate access for drilling equipment. Site clearing and grubbing, when unsupervised, and particularly in areas of wet soils and times of wet weather, may push organic debris into otherwise stable soils. Undercutting and clearing with a track hoe in lieu of bulldozers can minimize this.
3. Any stump holes or other depressions should be cleared of loose material and debris, and should then be back-filled with approved fill. The backfill should be placed in 6-inch thick lifts and compacted to 95% density in accordance with ASTM D-1557.
4. Any existing utilities that underlie the site should be relocated and their trenches back-filled with approved soil. The backfill should be placed in 6-inch lifts and compacted to 95% density according to ASTM D-1557.

5. Prior to backfill or fill placement, the subgrade should be proof rolled with a loaded dump truck to locate unstable or soft areas. Any unstable areas should then be investigated to determine the cause of the instability. If due to unsuitable soils, such as highly organic soils or soft clays, the areas should be undercut to firm soil and replaced with approved fill compacted in 6-inch lifts to minimum density of 95% in accordance with ASTM D-1557. If the instability is due to excess moisture in otherwise stable soil, the area should be drained and compacted to 95% density.
6. Any fill or backfill required to level or raise the site should be placed in 8 to 10-inch-thick, loose lifts and compacted by appropriate compaction equipment to 95% density in accordance with ASTM D-1557.
7. All of the fill and backfill (including utility line backfill) for this project should consist of clean, free draining granular soils. The fill should be free of objectionable roots, clay lumps, organics and other debris. The fill should be readily compactable during placement. Soils classified as SW, SP or SP-SM with a maximum of 15% passing a #200 sieve may be acceptable. Soils with the minus #200 fraction classified as MH, CH, OH, ML, CL or SC may be rejected. Soils with a maximum plasticity index of 25 and a maximum liquid limit 40 may be acceptable for use only beneath building pads which are situated well above the groundwater table with approval from the geotechnical engineer. Soils classified as SC or CL, exhibiting moisture sensitivity, soils with excessive clay content, or excessive moisture should not be used without approval from the geotechnical engineer. Approved sands will also need to be moisture conditioned as necessary to facilitate proper compaction throughout its entire depth. If utility trenches cannot be sufficiently dewatered to readily allow compaction of the specified pipe bedding material, then a class I (ASTM-D-2321) gravel or gravel mixture will be required.
8. Compact all footing excavations and slab subgrades to a minimum density of 95% in accordance with ASTM-D-1557, prior to placement on concrete. The footing excavations, and all prepared slab subgrade, should be maintained in a dry and compacted condition until the concrete is placed. Areas that are softened by water or that are disturbed by construction activity should be re-worked, re-compacted, or appropriately repaired to the required bearing and density. If necessary, stone backfill or other corrective measures may be implemented to stabilize footings. **For below grade tanks, the structure is typically over excavated one foot below finished subgrade elevation for the mat foundation and 12-inches of stone backfill is placed for stability during foundation construction. This is in addition to temporary dewatering measures.**

9. All slabs-on-grade receiving floor coverings should be supported on a minimum of 4-inches of granular, free-draining gravel or coarse sand to reduce moisture migration by capillarity. A vapor retarding membrane, overlying this granular base, is recommended to further reduce moisture migration into finished areas of the structure. Note that the use of these measures will not totally prevent moisture under or on top of slabs or beneath structures. To assist in reducing moisture beneath the structure, and to reduce the potential for mold growth, the site shall be graded and filled as necessary to direct drainage away from structures. If sub drains are installed, these alone may not prevent moisture vapor beneath the structure that can cause mold growth. (Also refer to paragraph 10 below). Care must be taken to not place concrete on top of wet soils. For example, if fill or natural soils experience heavy rain, the soils should be properly drained and dried, prior to placement of concrete. Otherwise moisture migration through the slab will occur.
10. Any footing excavations that are directly adjacent to the existing foundations should be done in small increments to avoid undermining them and causing a loss of support to the existing structure. If necessary, the excavations should be sheeted and braced and/or grouting should be performed to stabilize the soil in the immediate area.

VI. FOUNDATION RECOMMENDATIONS

The encountered surface soils can be made suitable for moderately loaded structures (150 kips for columns and 6 kips per linear kips for wall/strip loads) utilizing shallow spread pier and/or strip footing foundations with slab-on grade flooring.

Below grade water storage tanks can be constructed utilizing conventional spread footing and/or mat foundation systems without significant deflection.

Above grade water storage tanks can also be designed utilizing conventional spread footing and/or mat foundation systems as long as the finished water level in the tank resides a maximum of 10 feet above existing ground surface elevations. Net stress increases applied at the bottom of mat foundation elements approximating 1000 psf will yield approximately ½ inch of immediate settlement. Larger net stress increases can be acceptable if immediate settlements in excess of ½ inch are tolerable to the structural design.

The following shall be performed prior to utilizing shallow spread pier and/or strip footing foundations for support of structures:

- We recommend that all structural areas (plus a minimum of 10 feet beyond the perimeter of all structural areas) be stripped of any organics, stumps, roots and unsuitable surface soils. Stripping depths should be anticipated to extend 3 to 4 inches or more to effectively remove all surface organic materials.
- After stripping, all exposed subgrade soils shall be thoroughly compacted in-place to 95% of ASTM-D-1557 and pass proof-rolling inspections prior to backfilling/filling operations begin. Areas found to pump or deflect should be undercut to a competent material and backfilled with an approved compacted material.
- **Compaction efforts on exposed subgrade soils (after stripping) shall be made with a large vibratory smooth drum roller (Cat CS 74 or equivalent - centrifugal force range of 37,300 – 74,600 lb).** The exposed subgrade soils shall be inspected, tested and approved by Whitaker Laboratory personnel prior to backfilling/filling placement begins.
- Backfill and fill material required to replace the stripped areas and to raise the structural areas to finished subgrade elevations, should consist of granular soils and meet the requirements for material type and placement as outlined within the SUBGRADE PREPARATION RECOMMENDATIONS section of this report.
- After compaction efforts have been made, footing inspections shall be conducted by performing dynamic cone penetrometer testing within bottom of footing excavations to verify adequate bearing material is present. DCP testing shall extend to depths reaching 6 feet below existing grades. Subsurface bearing soils deemed unsuitable based upon dynamic cone penetrometer testing should be undercut to a competent material and backfilled with an approved compacted material.
- Please note that very loose sands were encountered within sounding CPT-2 bracketing elevations 3 ½ to 6 feet below existing grades. Due to very loose sands encountered within sounding CPT-2 on this site, it should be excepted for undercut and replacement in localized area of this site to depths reaching 6 feet below the existing ground surface elevations.

Once this is accomplished and verified during construction, shallow spread footings can be designed for support of structures utilizing safe soil bearing pressures of 2000 PSF without significant deflection.

All footings should have minimum plan dimensions of 24 inches. Bearing edges of slabs-on-grade should be a minimum of 18 inches wide. All footings and bearing edges should reside at least 12 inches below finished grade and above the groundwater table. Bearing elevations for footings shall meet local building code requirements for depth below finished grade elevations. Overall settlements on the order of one half inch should be anticipated due to foundation loads. Differential settlement is anticipated to be on the order of $\frac{1}{2}$ the overall settlement. Floor slabs can be designed utilizing a modulus of subgrade reaction "k" value of 150 pci.

Lateral loads can be resisted by passive earth pressure due to compacted structural fill placed against the sides of the footings. The upper 1-foot of resistance should be neglected unless the fill is confined by a pavement or floor slab. A soil unit weight of 110 pcf and passive earth pressure coefficient of 3.0 can be utilized in the analysis. Additionally, a friction coefficient of 0.35 between the concrete footings and underlying soil can be used in combination with passive earth pressures to resist lateral loads. The coefficient of friction should be applied to dead normal loads only.

VII. GROUNDWATER TABLE

The groundwater elevation can be expected to fluctuate with the tide, season of the year, surrounding ground surface conditions, and with recent rainfall amounts. Thus, approximate groundwater elevations shown on the CPT logs should be considered only for the time and date of observation. Pore water pressure measurements from CPT testing indicate groundwater resided approximately 6 feet below existing grades at the time of testing. Whitaker recommends the contractor determine groundwater levels prior to site work beginning.

Dewatering may be required during foundation construction if below-grade tanks and/or retaining walls are utilized. Typically, the groundwater level needs to be 24 inches below subgrade elevations to properly compact the subgrade and subsequent backfill materials.

Although dewatering techniques consisting of well point systems, sump pits with pumps, and/or drainage ditches are typically effective methods to lower groundwater, the means and methods for dewatering should ultimately be the responsibility of the contractor.

Due to the sandy nature of the near surface soils on this site, well point systems should be considered.

Please note that lowering the groundwater table can negatively impact existing foundations of adjacent structures. In an effort to minimize this potential impact, dewatering measures on this site shall not lower the groundwater table by more than 10 feet.

VIII. OTHER USEFUL INFORMATION FOR CONSTRUCTION

Due to the sandy nature of the subsurface soils on this site combined with tank excavations likely needing to extend to depths greater than 7 feet below existing grades, well point systems may be required to install the tanks.

If adequate dewatering is provided, excavations can be sloped back on a 1 vertical to 1 ½ horizontal slope. If adequate dewatering is not provided, trench boxes and/or shoring will be required below the groundwater table.

Buried tanks on this site should be designed to resist buoyant forces. For worst case scenario, the groundwater table should be considered to reside at existing grade elevations due to this site residing near/ adjacent to the river and/or marsh.

IX. VISUAL INSPECTION OF THE INFLUENT STRUCTURE

Findings:

1. The influent structure consists of old reinforced concrete (reinforcing steel was exposed in one area of the structure).
2. Measures have been taken to extend the life of the concrete. A protective membrane has been placed on the interior of the influent structure and a bituminous substance has been placed on the top edge of the concrete structure. It appears these measures were taken to protect the concrete from water intrusion and/or corrosion.
3. Multiple areas of the structure shows signs of deterioration. The following was observed while on site:
 - a. In localized areas on the top of the structure where the bituminous substance was placed, spalling of the concrete edge has occurred (see pages 3, 4, and 5 of appendix VI). This spalling has left the concrete edge exposed and more susceptible to further deterioration.
 - b. On the interior of the structure, multiple areas of the protective membrane have been split open, exposing the concrete behind the protective membrane. It is possible that this damage is caused by the corrosion of the reinforcing steel inside the concrete (see pages 6 and 7 of appendix VI).
 - c. One area of the structure, above what appeared to be the outflow discharge of the influent structure, reinforcing steel inside the concrete was exposed due to the deterioration of the surrounding concrete (see pages 8 and 9 of appendix VI).

- d. Whitaker personnel was able to examine the concrete in an area where the membrane was cracked/spilt at the top of the influent structure. The concrete was weak/brittle and could be scraped away with a knife (see pages 10 and 11 of appendix VI).

Due to the level of deterioration observed, complete removal and replacement of the tank structure seems more reasonable than additional/continuous attempts to repair/protect the existing concrete structure from further deterioration.

X. QUALITY CONTROL AND TESTING

Documented inspections and/or testing performed by Whitaker Laboratory personnel, at the following critical milestones during construction, will be required for the recommendations contained within this report to be validated:

Earth Work:

- After stripping, proofroll all exposed subgrade soil to check for stability. Also perform compaction testing to verify in-situ soils have been compacted in place prior to backfill or fill placement.
- Collect sample of proposed backfill & fill material. Perform laboratory testing and determine suitability for use (approve or disapprove).
- During backfill and/or fill placement: Perform density testing on each lift of backfill and/or fill soil.

Foundations:

- Once footings are excavated: Perform verification footing inspections within open footing excavations prior to placement of reinforcing steel or concrete.
- Footing inspections shall consist of advancing DCP auger borings to depths reaching 6 feet below existing grades. Bearing subgrade soils deemed unsuitable based upon visual inspection and/or dynamic cone penetrometer testing shall be undercut and replaced.

At the appropriate time, please contact Whitaker Laboratory, Inc. for budgetary and scheduling purposes for the performance of the above required inspection and testing services.

We further offer concrete, asphalt, masonry, and structural steel inspections and testing. Whitaker Laboratory, Inc. also performs observational services for mold mitigation, including observation of installation of vapor retarding membranes, subdrains, overall site drainage, and regularly scheduled observations after construction of site and landscape drainage, and monitoring of humidity and moisture in slabs and basement walls.

XI. QUALIFICATIONS OF REPORT

Any recommendations or opinions offered in this report are based on our interpretation of the data obtained from this investigation. It should be noted that underlying subsurface and soil conditions can, and do, vary considerably within short lateral distances. Regardless of the thoroughness of any subsurface investigation, it is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis. For this reason, we recommend that the site preparation and foundation construction for this project be monitored closely. If deviations of the soil conditions from those presented in this report appear, we will be glad to furnish any additional analyses and recommendations that may be required.

This report was made to investigate subsurface properties of the site and is not intended to serve as a wetlands survey, toxic mold assessment, or environmental site assessment. No effort has been made to define, delineate, or designate any area as wetlands or an area of environmental concern or contamination. Any references to low areas, poorly drained areas, etc. are related to geotechnical applications. Any recommendations regarding drainage and earthwork are made on the basis that such work can be permitted and performed in accordance with the current laws pertaining to wetlands, storm water runoff, and environmental contamination.

This report does not attempt to define or represent any FEMA, or otherwise designated, flood, erosion, scour, or other hazardous zones; nor does it presume to reflect that governmental or other authorities will grant approval of the project and issue appropriate permits.

WARRANT: WHITAKER LABORATORY, INC. and its professional engineers strive to perform all services in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession practicing in the same locality and under similar conditions. No other warranty or representation, expressed or implied, is included or intended in this agreement, in any report, opinion, document, or otherwise. We carry commercial general liability insurance, including completed operations, and professional liability insurance in aggregate amounts deemed adequate, and we comply with the statutory requirements for workmen's compensation insurance. Accordingly, by accepting and relying on the contents of this report, the liability of WHITAKER LABORATORY, INC. and its professional engineers, to the client, owner, or any other

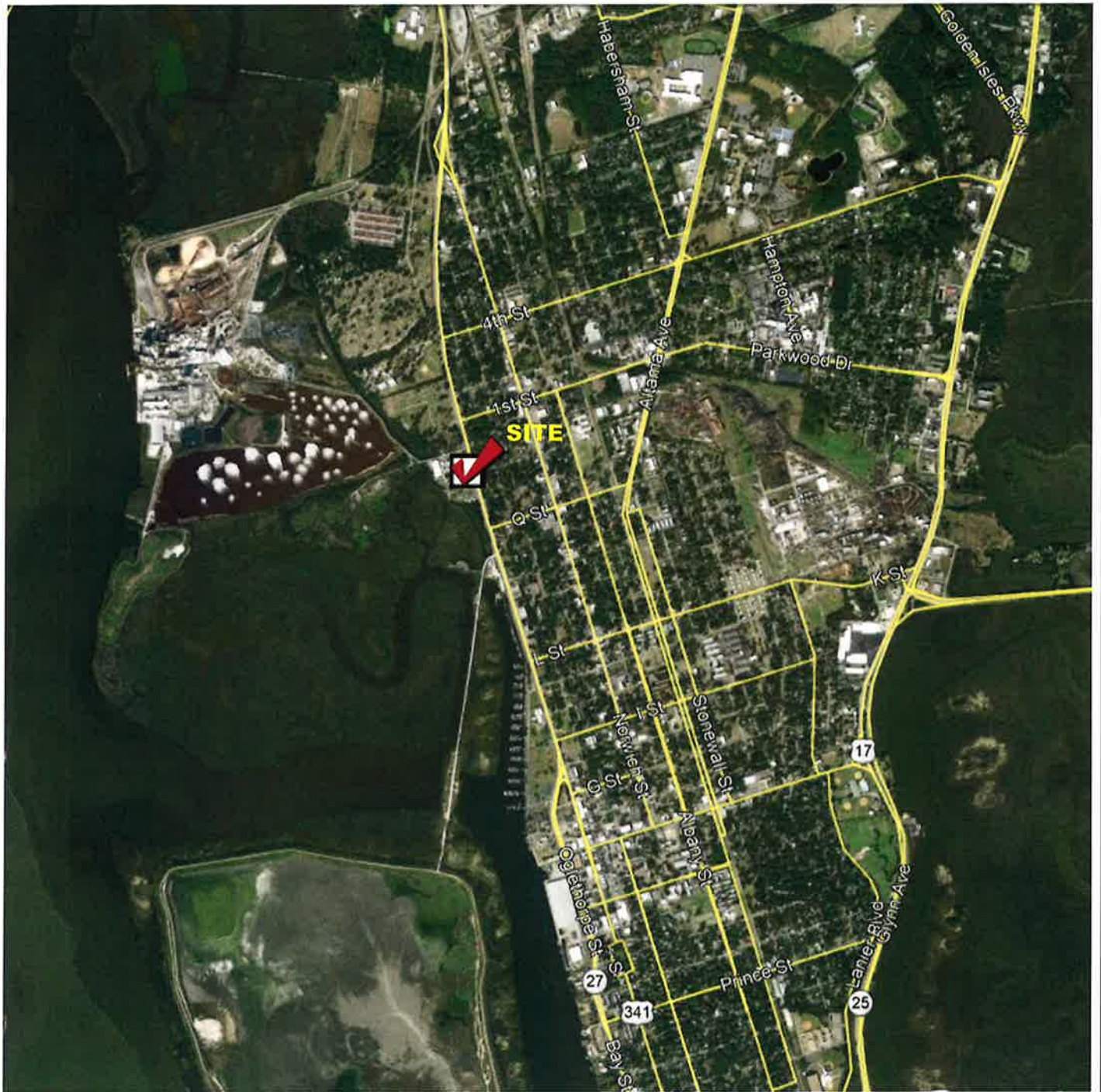
party, for any loss or damage, resulting from any cause, including professional acts, errors, omissions, negligence, toxic mold and other environmental claims, breach of warranty or breach of contract, shall not exceed the total compensation received by us for services related to this project; and client will defend, settle, and discharge any claims or allegations of liability for same against us by others. If client desires higher monetary limits of our liability, we will be pleased to discuss such higher limits and the impact on liability and fees.

In the event the client makes a claim against us, at law or otherwise, for any alleged act, error, omission, negligence, breach of warranty or breach of contract, arising from the performance of our services, it is mutually agreed that initially, the client and Whitaker Laboratory, Inc. will attempt to resolve such dispute through direct negotiations between the appropriate representatives of each party. Secondly, if such negotiations are not fully successful, the parties agree to resolve any remaining disputes by formal nonbinding arbitration mediation in accordance with the rules and procedures to be agreed upon by the parties. Mediation is a pre-condition to litigation. The exclusive venue for any disputes relating to Whitaker Laboratory's service shall be in Chatham County, GA. Furthermore, if the client fails to prove such claim, then client shall pay all costs accrued by us in defending ourselves.

TITLE: The ownership of opinions, technical ideas, methods and means, drawings, calculations, and other data developed by us during the course of preparing proposals or rendering engineering services remains exclusively with us. It is a condition of this report or proposal that the client agrees not to use the opinions, technical ideas, methods and means, drawings, calculations or any other data for projects or locations, other than those specifically addressed in the report, and that no one other than the client may use this report, without the written permission of WHITAKER LABORATORY, INC.

APPENDIX I

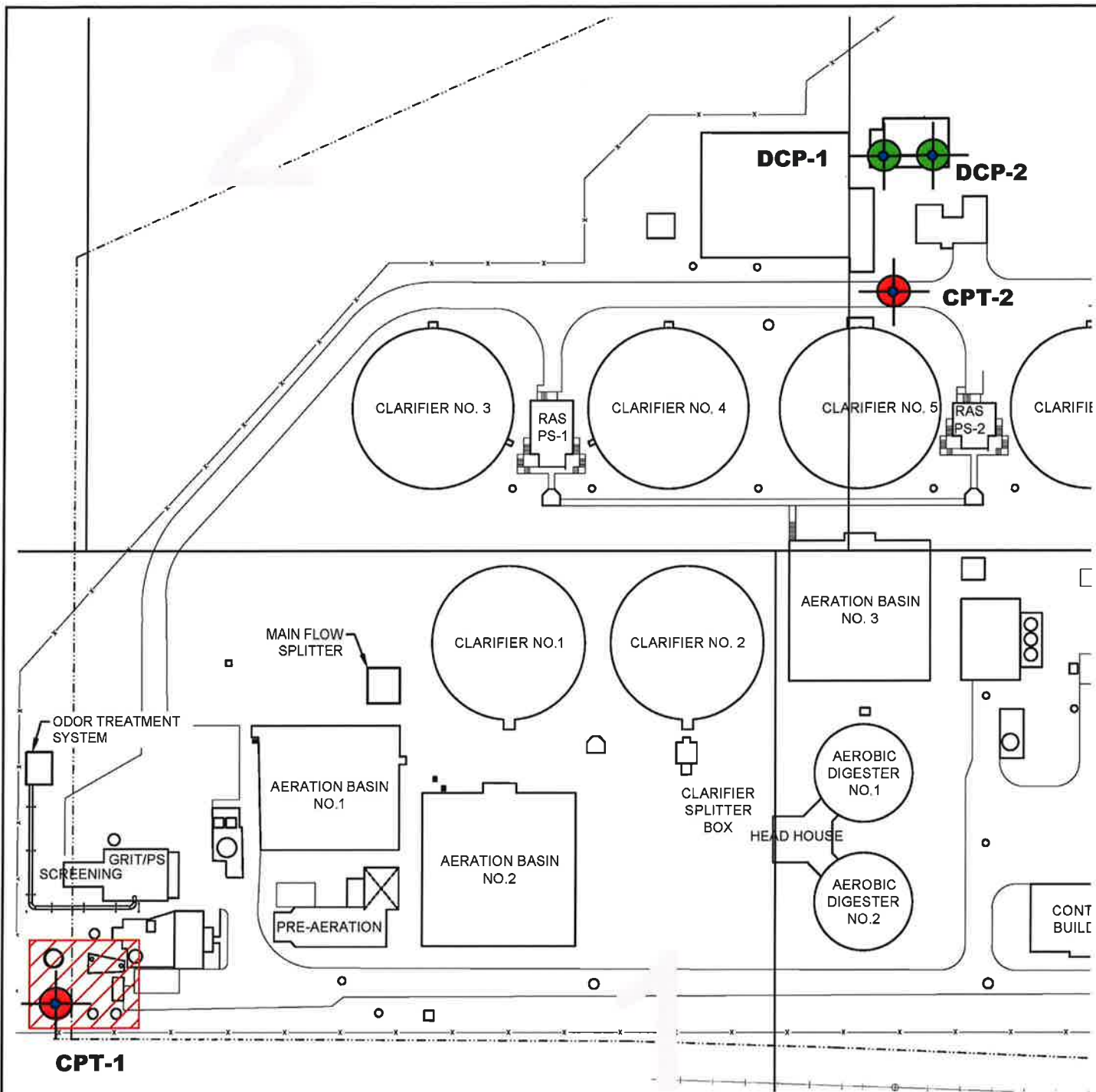
SITE VICINITY & BORING LOCATION PLANS



Site Vicinity Map

Academy Creek WCPF
Brunswick, Georgia





Boring Location Plan

Academy Creek WCPF
Brunswick, Georgia



ALL BORING LOCATIONS ARE APPROXIMATE, & ARE BASED ONLY ON FIELD ESTIMATES.

WHITAKER LABORATORY, INC.

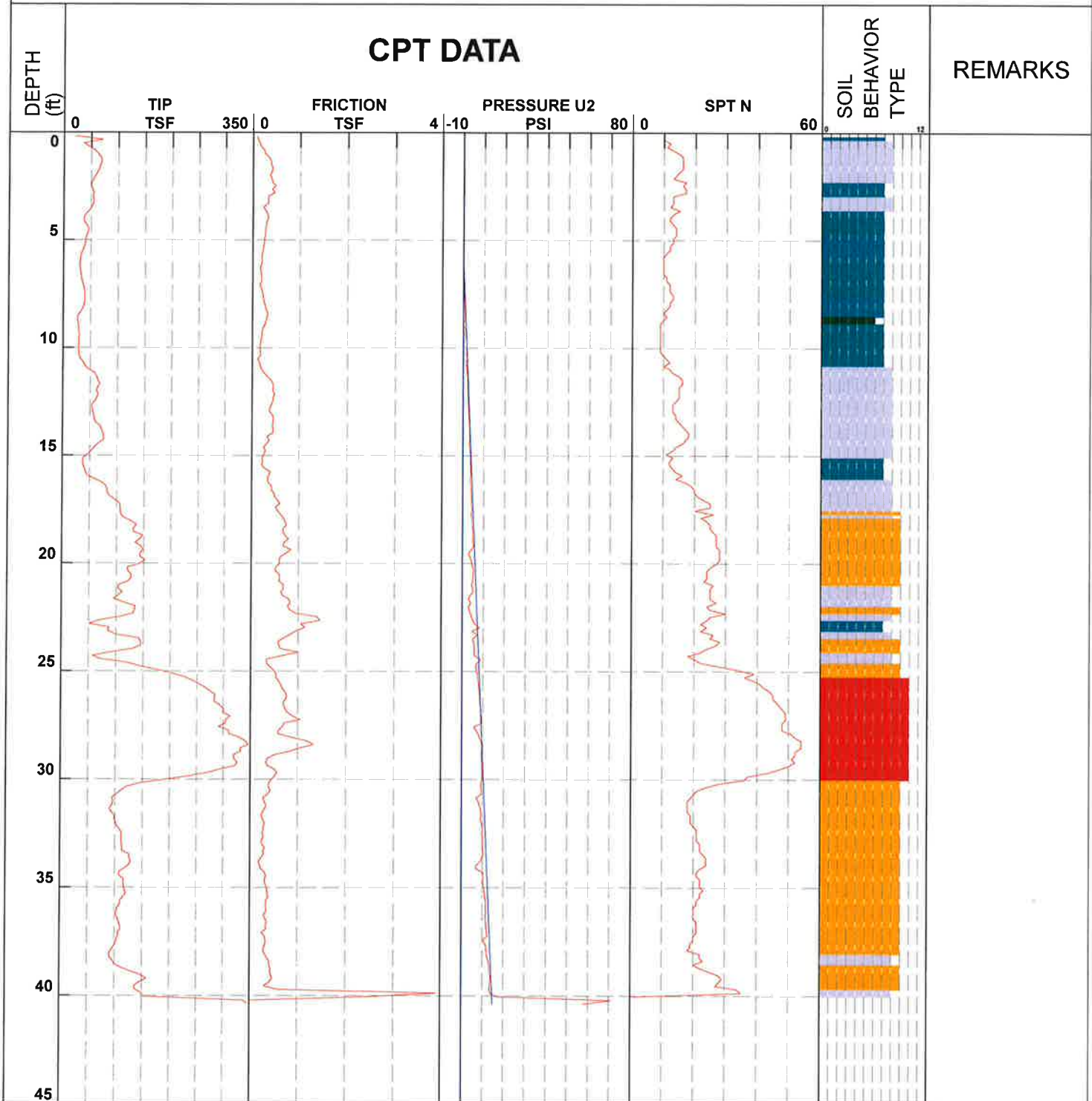


APPENDIX II
BORING RECORDS



Whitaker Laboratory, Inc.

Job Name Academy Creek WCPF Location Brunswick GA Client GMC Network
 Date & Time 10/16/2019 10:37:11 AM Hole Number CPT- 1 Cone Number DDG0862
 Operator Kicklighter Job Number Academy Creek WCPF
 Groundwater = 6 feet approx.

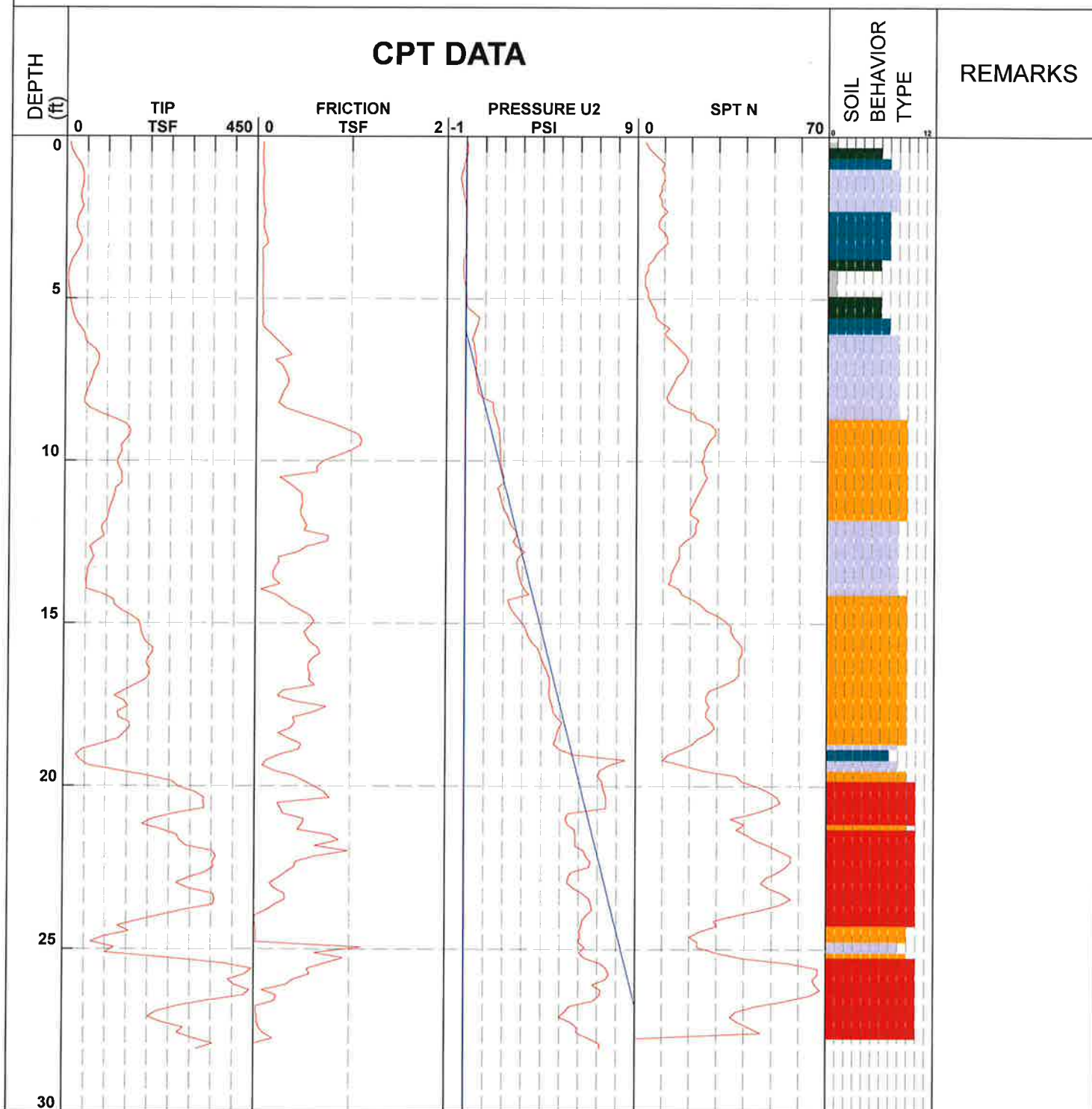


- | | | | |
|----------------------------|-------------------------------|------------------------------|----------------------------------|
| 1 - sensitive fine grained | 4 - silty clay to clay | 7 - silty sand to sandy silt | 10 - gravelly sand to sand |
| 2 - organic material | 5 - clayey silt to silty clay | 8 - sand to silty sand | 11 - very stiff fine grained (*) |
| 3 - clay | 6 - sandy silt to clayey silt | 9 - sand | 12 - sand to clayey sand (*) |



Whitaker Laboratory, Inc.

Job Name Academy Creek WCPF Location Brunswick GA Client GMC Network
 Date & Time 10/16/2019 11:50:07 AM Hole Number CPT- 2 Cone Number DDG0862
 Operator Kicklighter Job Number Academy Creek WCPF
 Groundwater = 6 feet approx.



- | | | | |
|----------------------------|-------------------------------|------------------------------|----------------------------------|
| 1 - sensitive fine grained | 4 - silty clay to clay | 7 - silty sand to sandy silt | 10 - gravelly sand to sand |
| 2 - organic material | 5 - clayey silt to silty clay | 8 - sand to silty sand | 11 - very stiff fine grained (*) |
| 3 - clay | 6 - sandy silt to clayey silt | 9 - sand | 12 - sand to clayey sand (*) |

WHITAKER LABORATORY, INC.
P.O. BOX 7078
SAVANNAH, GEORGIA 31418

Project Name Academy Creek WCPF **Date** 10/16/2019

Project Location	Brunswick, GA
-------------------------	----------------------

Boring Number _____ **Field Engineer** **Josh Kicklighter**

Ground Surface Elevation _____ **Ground Water Elevation** _____

[illegible]

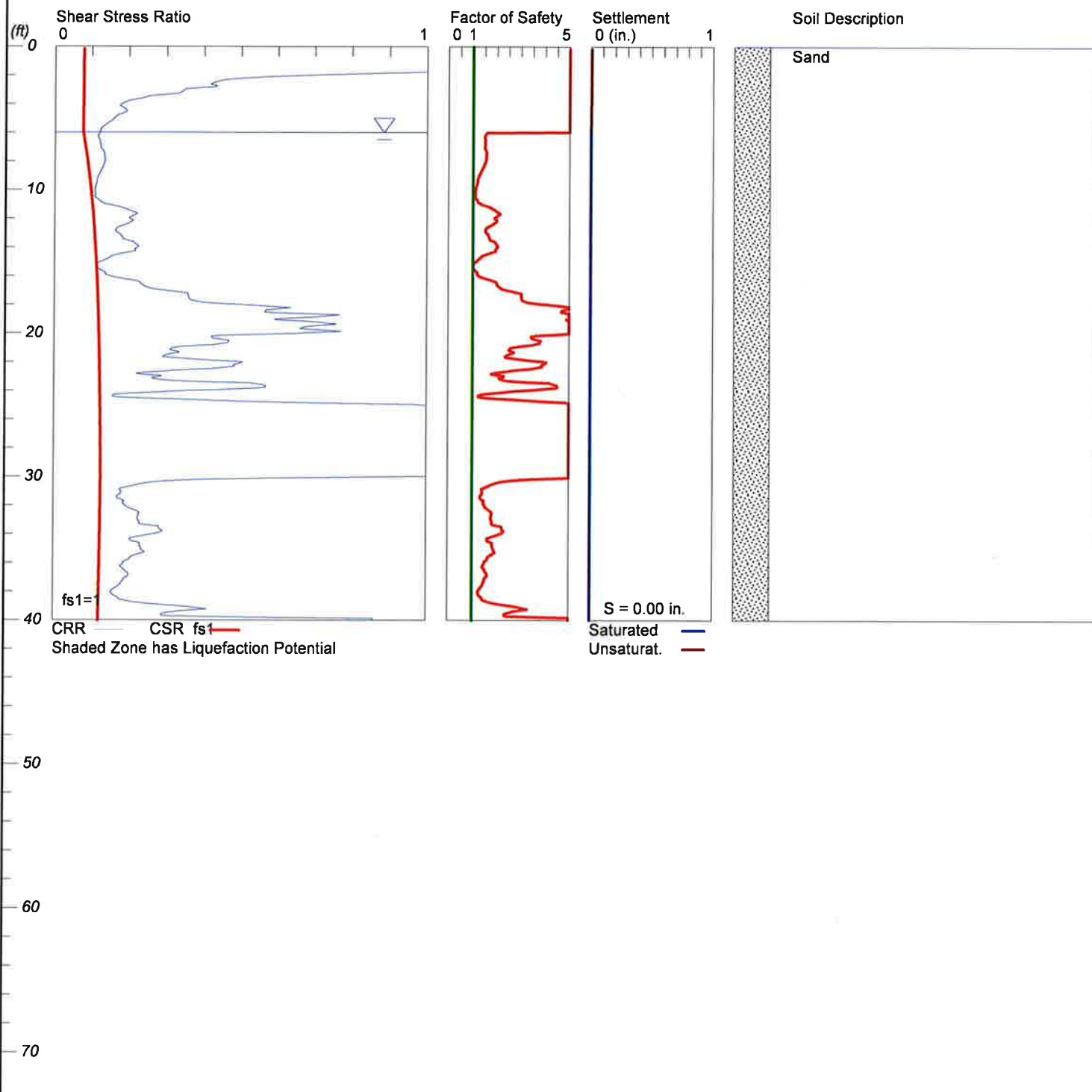
APPENDIX III

SEISMIC PARAMETERS

Academy Creek WTP

Hole No.=CPT-1 Water Depth=6 ft

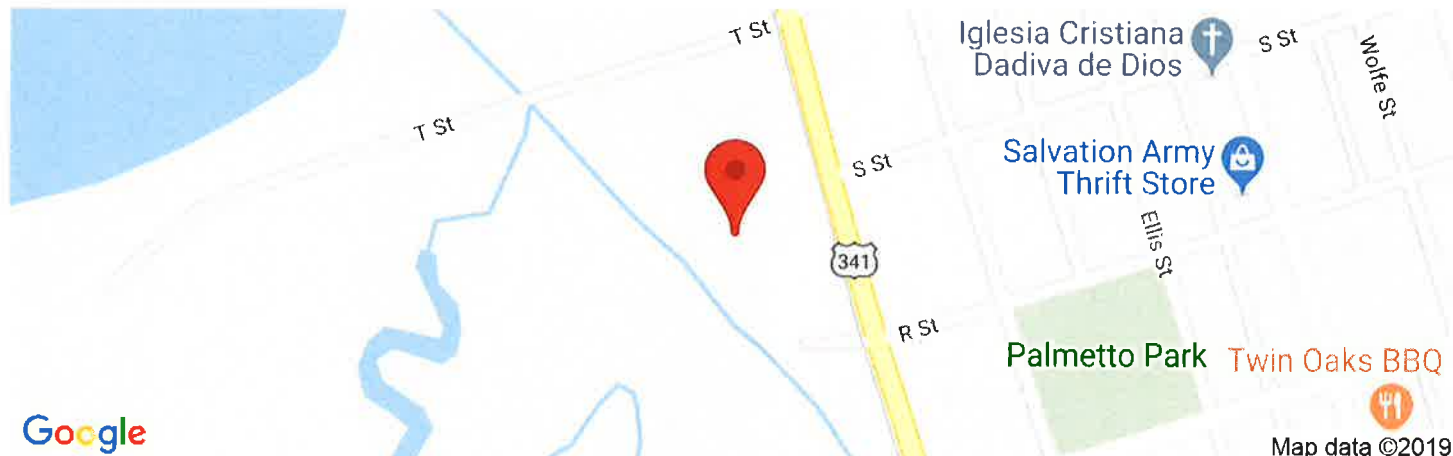
Magnitude=7.3
Acceleration=0.12g





Academy Creek WCPF, Brunswick, GA

Latitude, Longitude: 31.1672, -81.5030

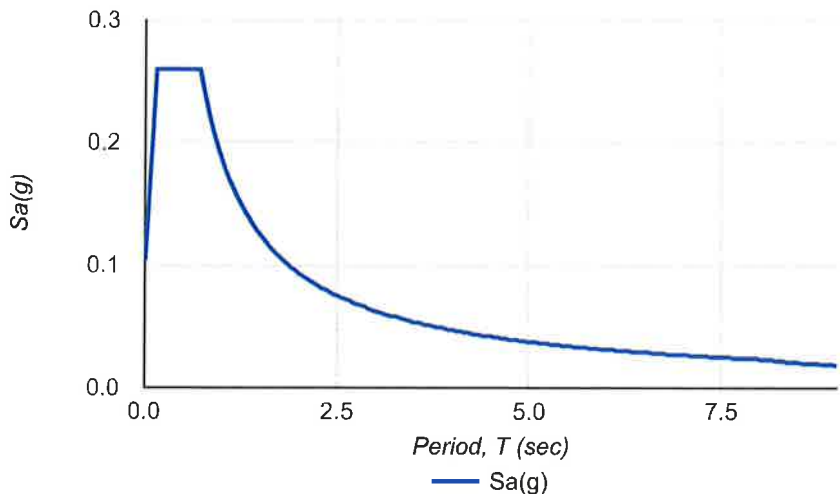


Date	10/18/2019, 8:14:00 AM
Design Code Reference Document	ASCE7-10
Risk Category	III
Site Class	D - Stiff Soil

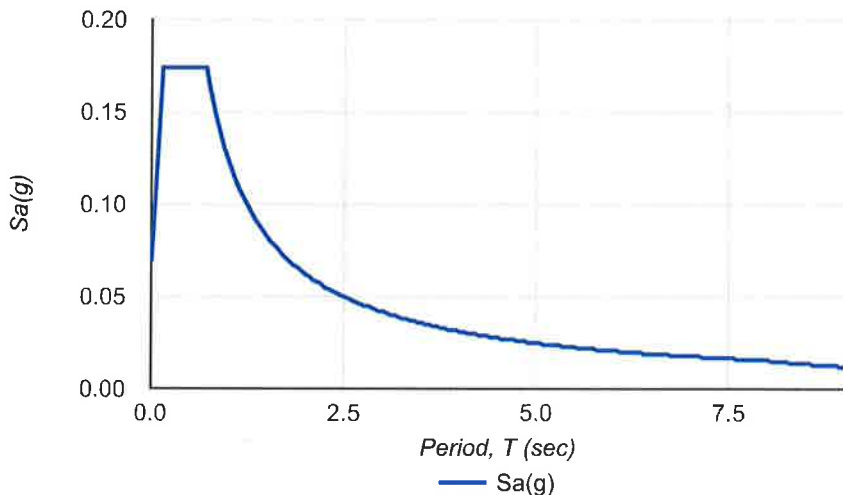
Type	Value	Description
S_S	0.163	MCE_R ground motion. (for 0.2 second period)
S_1	0.078	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.26	Site-modified spectral acceleration value
S_{M1}	0.187	Site-modified spectral acceleration value
S_{DS}	0.174	Numeric seismic design value at 0.2 second SA
S_{D1}	0.125	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.079	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.126	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
S_{sRT}	0.163	Probabilistic risk-targeted ground motion. (0.2 second)
S_{sUH}	0.193	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
S_{sD}	1.5	Factored deterministic acceleration value. (0.2 second)
S_{1RT}	0.078	Probabilistic risk-targeted ground motion. (1.0 second)
S_{1UH}	0.092	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S_{1D}	0.6	Factored deterministic acceleration value. (1.0 second)
$PGAd$	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.843	Mapped value of the risk coefficient at short periods
C_{R1}	0.846	Mapped value of the risk coefficient at a period of 1 s

MCER Response Spectrum



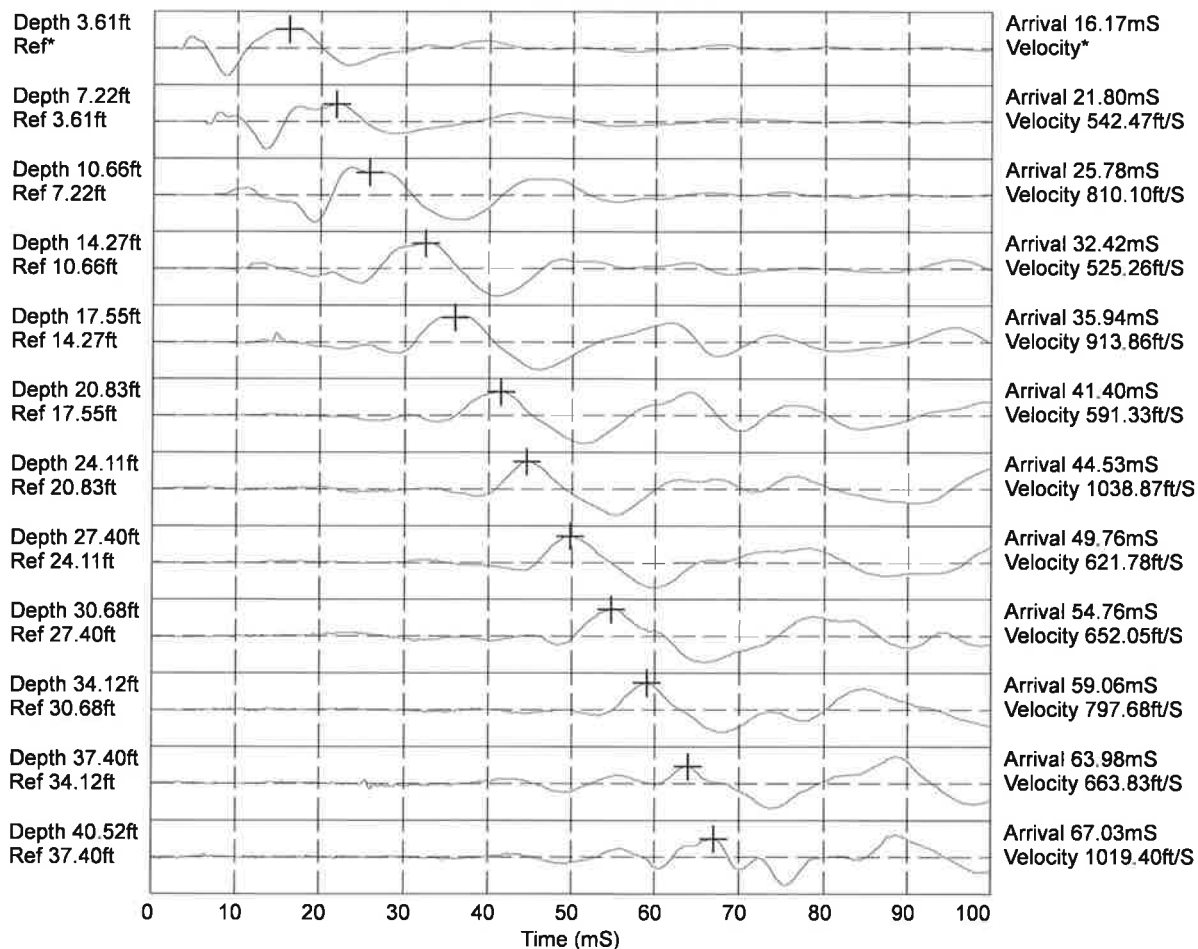
Design Response Spectrum



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HOLE NUMBER: CPT- 1



Hammer to Rod String Distance (ft): 3.28

* = Not Determined

HOLE NUMBER: CPT- 1

Academy Creek WCPF, Brunswick,GA
Shear wave IBC Site Class

CPT-1 <i>ft</i>	VS <i>ft/sec</i>	Di/vs
4	700	0.00471429
7	542	0.00608856
11	810	0.00407407
14	525	0.00628571
17	913	0.00361446
21	591	0.00558376
24	1038	0.00317919
27	621	0.00531401
30	652	0.00506135
34	797	0.00414053
37	663	0.00497738
40	1019	0.00323847
44	700	0.00471429
47	750	0.00440000
50	750	0.00440000
54	750	0.00440000
57	800	0.00412500
60	800	0.00412500
63	800	0.00412500
67	800	0.00412500
70	800	0.00412500
73	800	0.00412500
77	800	0.00412500
80	800	0.00412500
83	800	0.00412500
87	800	0.00412500
90	800	0.00412500
93	800	0.00412500
96	800	0.00412500
100	800	0.00412500

0.13193606

Weighted 758

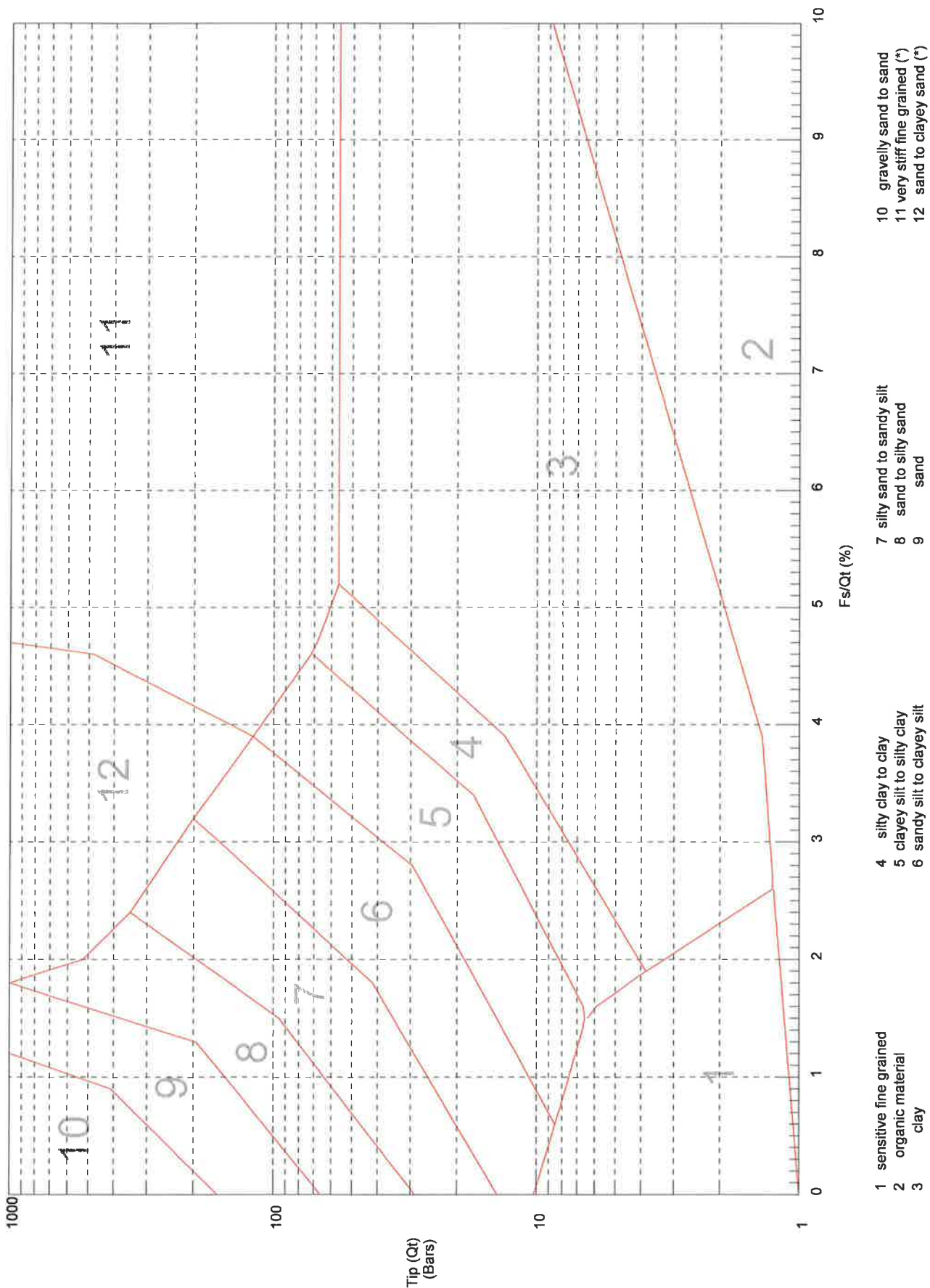
Red values were conservatively assumed
Weighted VS between 600 - 1200 is site D

APPENDIX IV

IMPORTANT GENERAL NOTES

Whitaker Laboratory, Inc.

Classification Data:
Robertson and Campanella UBC-1983



GENERAL NOTES

The "standard" penetration resistance is an indication of the density of cohesion less soils and of the strength of cohesive soils. The "standard" penetration test is measured with a 1.4 inch I.D., 2 inch O.D., sampler driven one (1) foot with a 140 pound hammer falling 30 inches.

RELATIVE DENSITY OF SOIL THAT IS PRIMARILY SAND

Number of Blows	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 20	Firm
21 - 30	Very firm
31 - 50	Dense
Over 51	Very dense

CONSISTENCY OF SOIL THAT IS PRIMARILY SILT OR CLAY

Number of Blows	Consistency
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very stiff
Over 31	Hard

While individual test boring records are considered to be representative of subsurface conditions at the respective boring locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

The subsoil stratification shown on these profiles is not warranted but is estimated based on accepted soil engineering principles and practices and reasonable engineering judgment.

Unless notified, samples will be disposed of after 60 days.

GROUP

MAJOR DIVISIONS SYMBOLS TYPICAL NAMES

COARSE-GRAINED SOILS

More than 50% retained on No. 200 Sieve*

GRAVELS

50% or more of coarse fraction retained on No. 4 sieve

CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silty mixtures
	GC	Clayey gravels, gravel sand clay mixtures

SANDS

More than 50% of coarse fraction passes No. 4 sieve

CLEAN SANDS	SW	Well graded sand and gravelly sands, little or no fines
	SP	Poor graded sands and gravelly sands, little or no fines
SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand clay mixtures

FINE GRAINED SOILS

50% or more passes No. 200 Sieve*

SILTS AND CLAYS

Liquid Limit 50% or less

ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silty clays of low plasticity

SILTS AND CLAYS

Liquid Limit greater than 50%

MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity

HIGHLY

ORGANIC SOILS

PT	Peat, muck and other highly organic soils
----	---

*Based on the material passing the 3 in. (75 mm) sieve.

APPENDIX V
GPR REPORT AND MAP



GEOPHYSICAL INVESTIGATION REPORT

PERFORMED AT:

**2900 Newcastle Street
Brunswick, GA 31520**

PREPARED FOR:

**Blake Jones
Whitaker Laboratory, Inc.
2500 Tremont Road
Savannah, GA 31405**

PREPARED BY:

**Eduardo Barrios
Geophysicist
Enviroprobe Service, Inc.
81 Marter Avenue
Mount Laurel, NJ 08054
(856) 858-8584
(800) 596-7472**

October 17, 2019

1.0 INTRODUCTION

Enviroprobe Service, Inc. (Enviroprobe) is an environmental investigation services firm which provides monitoring well installation (HSA), Geoprobe (DPT) drilling services and Environmental & Engineering Geophysics (EEG) services to the environmental consulting and engineering community.

Enviroprobe conducted a subsurface geophysical investigation at the subject property within client-specified areas of concern. Due to conditions and objectives, the investigation utilized a GSSI UtilityScan HS cart-mounted Ground Penetrating Radar (GPR) unit with a 350 MHz antenna, a Fisher TW-6 metallic locator, a Radiodetection RD7000TX3 multi-frequency transmitter, and a Radiodetection RD7000PXL receiver.

Ground penetrating radar (commonly called GPR) is a geophysical method that has been developed over the past thirty years for shallow, high-resolution, subsurface investigations of the earth. GPR uses high frequency pulsed electromagnetic waves (generally 10 MHz to 2,000 MHz) to acquire subsurface information. An EM wave is propagated downward into the ground by a transmitting antenna. Where abrupt changes in electrical properties occur in the subsurface, a portion of the energy is reflected back to the surface. This reflected wave is detected by a receiver antenna and transmitted to a control unit for real time processing and display. The penetration depth of the GSSI unit varies from several inches to tens of feet according to site-specific conditions. The penetration depth decreases with increased soil conductivity. The penetration depth is the greatest in ice, dry sands, and fine gravels. Clayey, highly saline or saturated soils, areas covered by concrete, foundry slag, or other highly conductive materials greatly reduce GPR penetration. GPR is a method that is commonly used for environmental, engineering, archaeological, and other shallow investigations.

The Fisher TW-6 metallic locator is designed to find pipes, cables and other metallic objects such as underground storage tanks (USTs). The TW-6 transmitter generates an electromagnetic field that induces electrical currents in the subsurface. These currents produce a secondary electromagnetic field that is measured by the TW-6 receiver. One surveyor can carry both the transmitter and receiver together to search for underground metallic objects, although the TW-6 response can also be affected by the electrical properties of non-metallic materials in the subsurface.

The Radiodetection (RD) transmitter and receiver are commonly used for pipe and cable locating. The multi-frequency transmitter can be directly connected, clamped, or used to induce a signal in a target line while the multi-frequency receiver is used to measure the signal from energized lines.

2.0 SCOPE OF WORK

On October 15, 2019, a geophysicist from Enviroprobe Service Inc. was mobilized to the subject property to perform a geophysical investigation. The purpose of this investigation was to designate underground conduits/utilities and clear proposed boring locations through client-selected areas. These areas consisted of concrete and asphalt and natural soil surfaces.

3.0 SURVEY RESULTS

The survey was conducted using a cart-mounted GPR unit, a Fisher TW-6 metallic locator, and a RD unit. The RD unit was used to trace common utilities from sources in and around the survey area. The RD receiver was also used in the passive mode to search for live underground electrical power cables and other utilities emitting 60Hz electromagnetic signals. When possible, the locations of utilities were confirmed with the GPR. A GPR survey was also performed in a grid pattern in at least two orthogonal directions to search for underground utilities and USTs. Designated utilities were marked on-site with spray paint using the following colors: orange – communications, red – electric and green - sewers. [See Figure 1 and attached Whitaker Lab 101519 Brunswick GA.dwg].

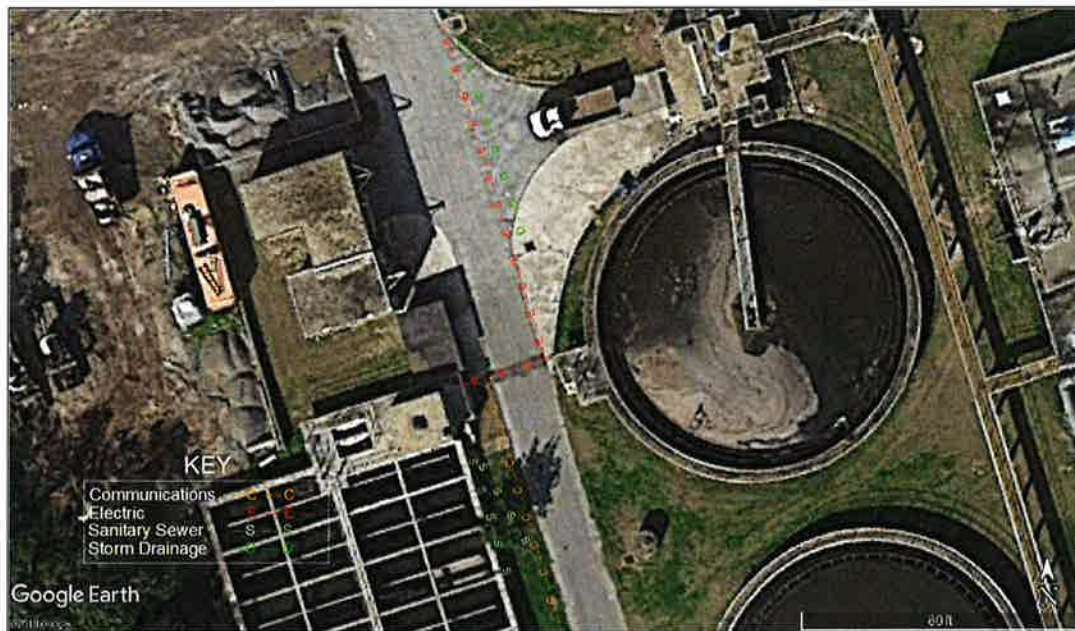


Figure 1. Area of designated utilities. *(Not to scale)

The GPR and TW-6 were used in a grid pattern over all client-selected areas when possible. Based on the results of the GPR and TW-6 surveys, no metallic anomalies consistent with an UST were detected within the survey area.

4.0 LIMITATIONS

The client-selected areas contained obstructions including equipment and landscaping. These objects prevented a thorough investigation of the spaces beneath and immediately adjacent to them.

Due to surface conditions and subsurface content, the GPR signal penetration was estimated at less than 6 ft in the majority of the survey area. This penetration was reduced in areas of concrete cover.

The TW-6 survey was kept up to 6 feet away from above ground objects containing metals depending on the sizes, shapes and positions of the metal objects. The TW-6 survey was not effective in areas with reinforced concrete.

Due to the dielectric properties of the subsurface, clay, plastic polymer, and fiberglass utilities may not have been detected.

All field services were conducted in compliance with the industry standard of care guidelines found in ASCE 38-02 (Level B).

5.0 WARRANTIES

The field observations and measurements reported herein are considered sufficient in detail and scope for this project. Enviroprobe Service, Inc. warrants that the findings and conclusions contained herein have been promulgated in accordance with generally accepted environmental engineering methods. There is a possibility that conditions may exist which could not be identified within the scope of this project and were not apparent during the site activities performed for this project.

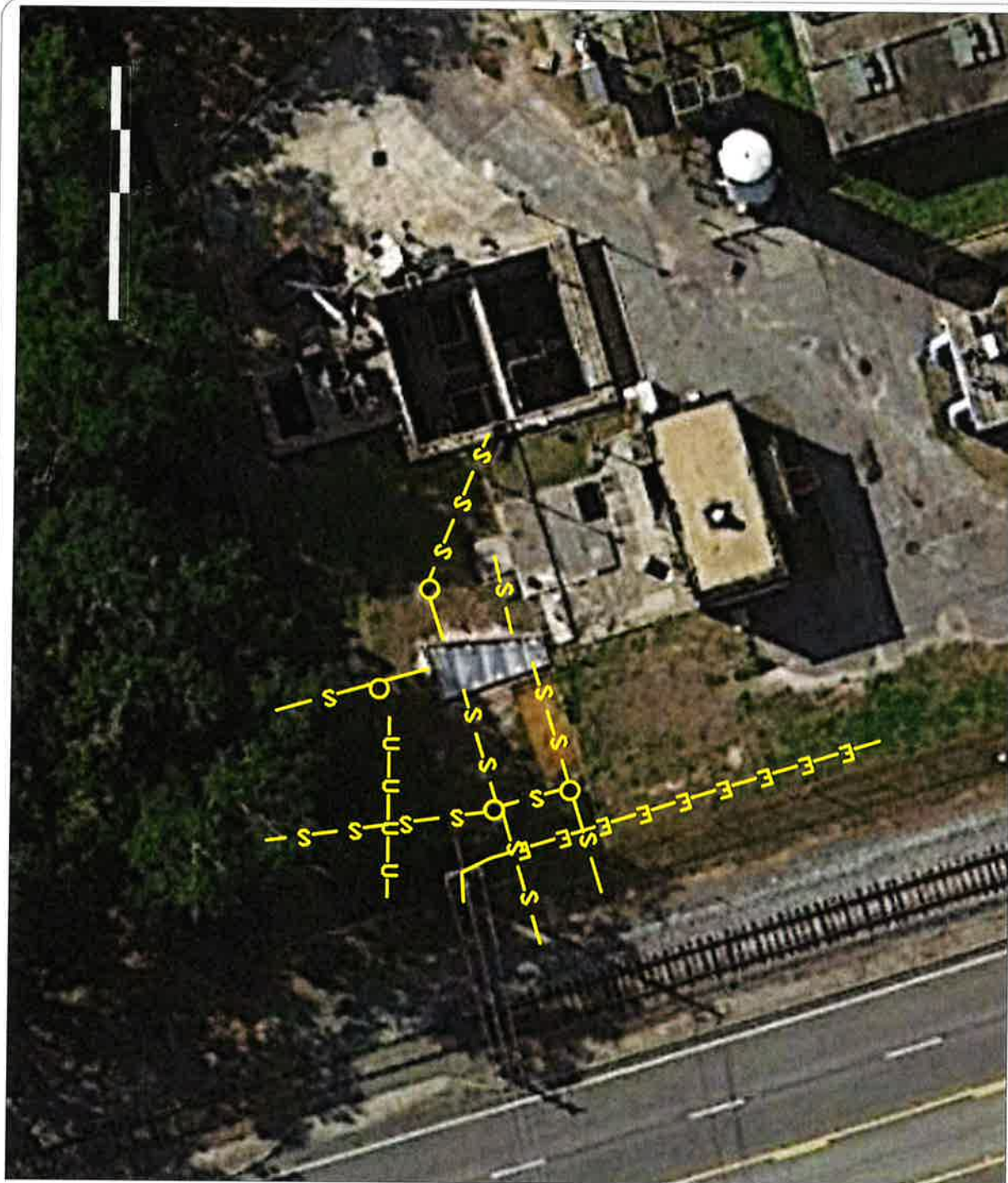
Enviroprobe represents that the services were performed in a manner consistent with that level of care and skill ordinarily exercised by environmental consultants under similar circumstances. No other representations to Client, express or implied, and no warranty or guarantee is included or intended in this agreement, or in any report, document, or otherwise.

Enviroprobe Service, Inc. believes that the information provided in this report is reliable. However, Enviroprobe cannot warrant or guarantee that the information provided by others is complete or accurate. No other warranties or guarantees are implied or expressed.

GPR data is subject to signal anomalies and operator interpretation. The GPR data is intended to provide the locations of areas of concern requiring additional investigation or the approximate location of underground structures and utilities. Great care must be utilized when excavating and/or drilling around underground structures and utilities since GPR data can only be used for estimation purposes and GPR data is subject to misinterpretation. Enviroprobe can not guarantee that utilities, post-tension cables, and/or rebar will not be incurred during drilling, cutting, coring, or excavating activities.

This report was prepared pursuant to the contract Enviroprobe has with the Client. That contractual relationship included an exchange of information about the property that was unique and between Enviroprobe and its client and serves as the basis upon which this report was prepared. Because of the importance of the communication between Enviroprobe and its client, reliance or any use of this report by anyone other than the Client, for whom it was prepared, is prohibited and therefore not foreseeable to Enviroprobe.

Reliance or use by any such third party without explicit authorization in the report does not make said third party a third party beneficiary to Enviroprobe contract with the Client. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at the third party's risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party.



KEY

SANITARY SEWER	—S—S—S—
STORM SEWER	—D—D—D—
ELECTRIC	—E—E—E—E—
UNKNOWN	—U—U—U—U—
MANHOLE	○ □



This site plan was produced from data positioned by differential GPS measurements collected in the field. Due to the errors normally present in DGPS data, this document is not intended or represented to be of survey precision. Caution should be used in all field measurements based on this site plan.

As with any geophysical method, it must be stressed that caution be used during any excavation or intrusive testing in proximity of any anomalies indicated in this document. The absence of detected signatures does not preclude the possibility that targets exist. The geophysical data and results presented in this site plan are based upon the application of scientific principles and professional judgements to certain facts with resultant subjective interpretations. Professional judgements expressed herein are based on the facts currently available within the limits of the existing data, scope of work, budget, and schedule.

This document was prepared pursuant to the contract Enviroprobe has with the client. That contractual relationship included an exchange of information about the subject site that was unique and between Enviroprobe and the client, and serves as the basis upon which this document was prepared. Because of the importance of the communication between Enviroprobe and its client, reliance or any use of this document by anyone other than the client, for whom it was prepared, is prohibited and therefore not foreseeable to Enviroprobe.

Reliance or use by any such third party without explicit authorization in the document does not make said third party a third party beneficiary to Enviroprobe's contract with the client. Any such unauthorized reliance on or use of this document, including any of its information or conclusions, will be at the third party's risk. For the same reasons, no warranties or representations, expressed or implied in this document, are made to any such third party.

DRAWING NO. _____
 SHEET NO. _____
 1 of 1

DESIGNATED UNDERGROUND UTILITIES
at 2900 Newcastle Street, Brunswick, GA 31520

FOR
WHITAKER LABORATORY, INC
2500 Tremont Road, Savannah, Georgia 31405

ENVIROPROBE SERVICE INC.

81 West Avenue, North Laurel, MD 20634
Phone: (202) 512-1422 Fax: (202) 512-1423

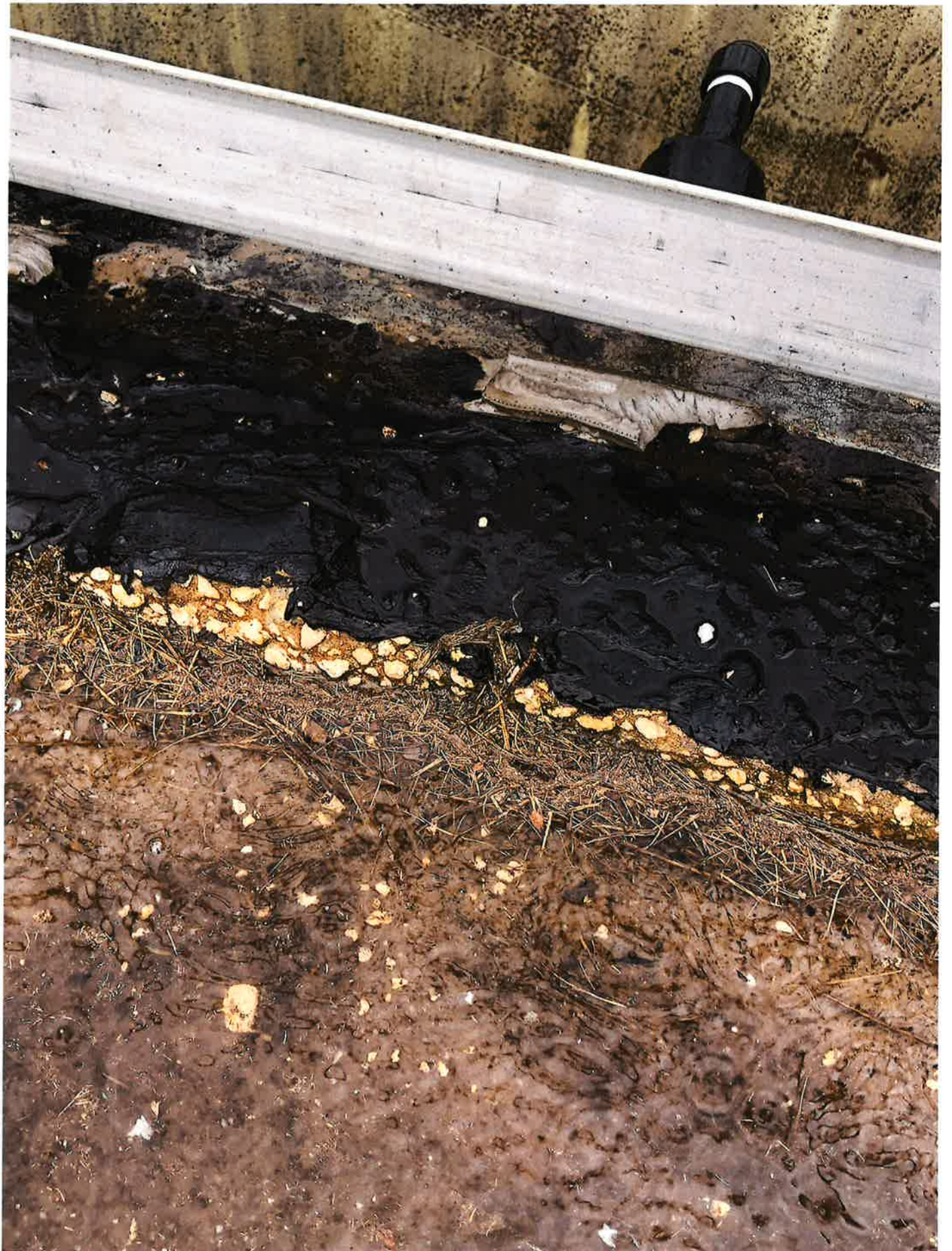
DATE: _____
 TIME: _____
 BY: _____

APPENDIX VI
PHOTOS OF TOP OF INFLUENT STRUCTURE

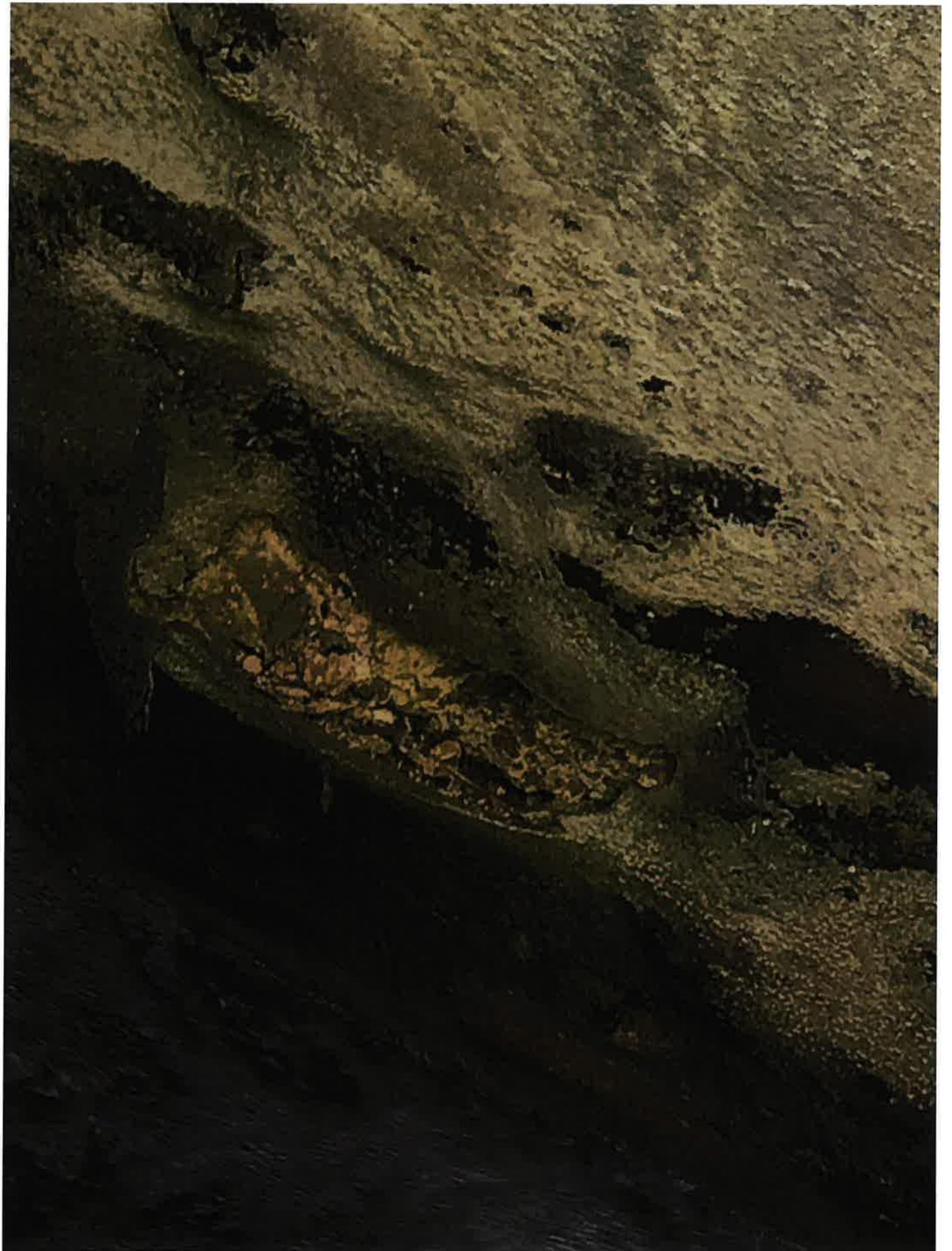




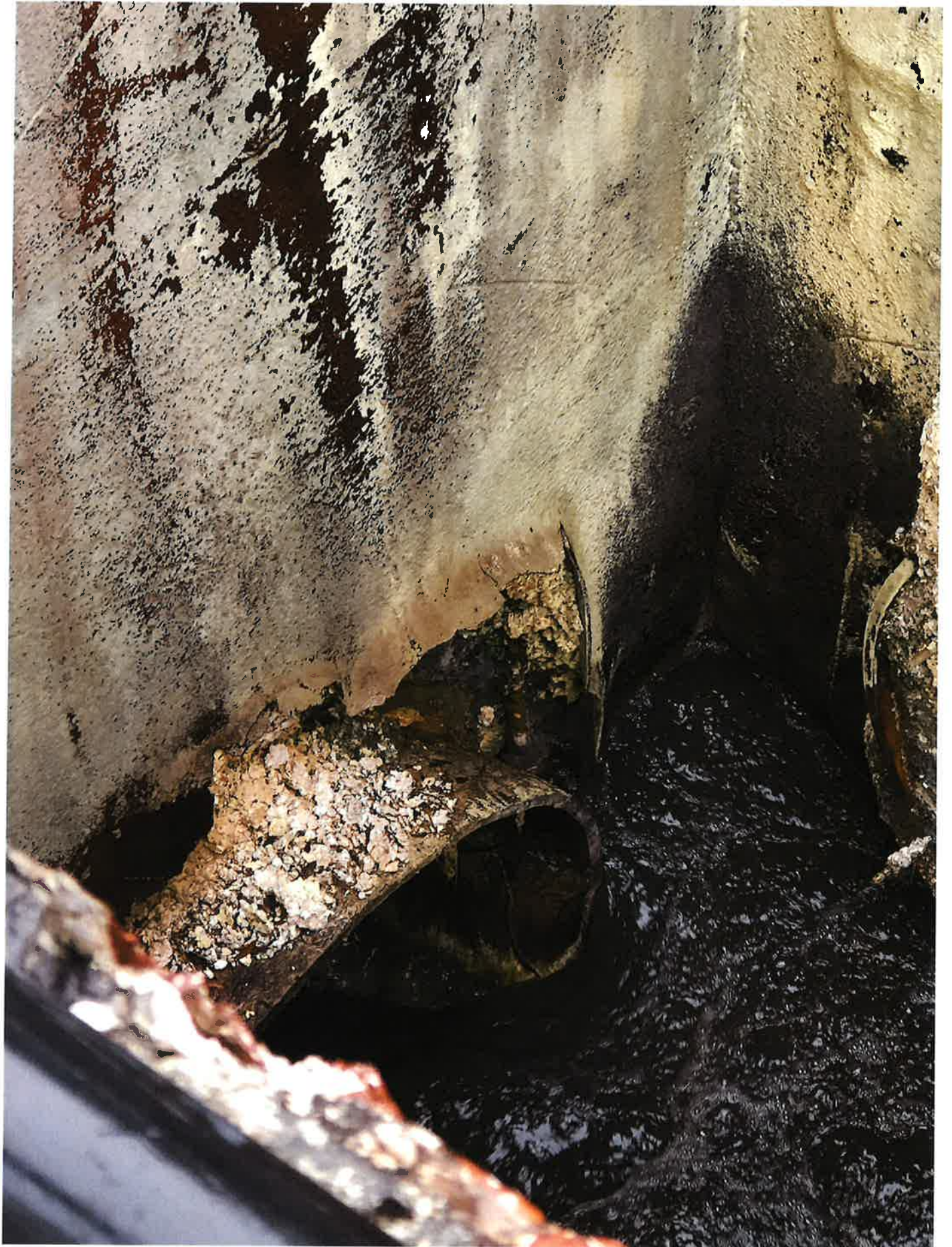


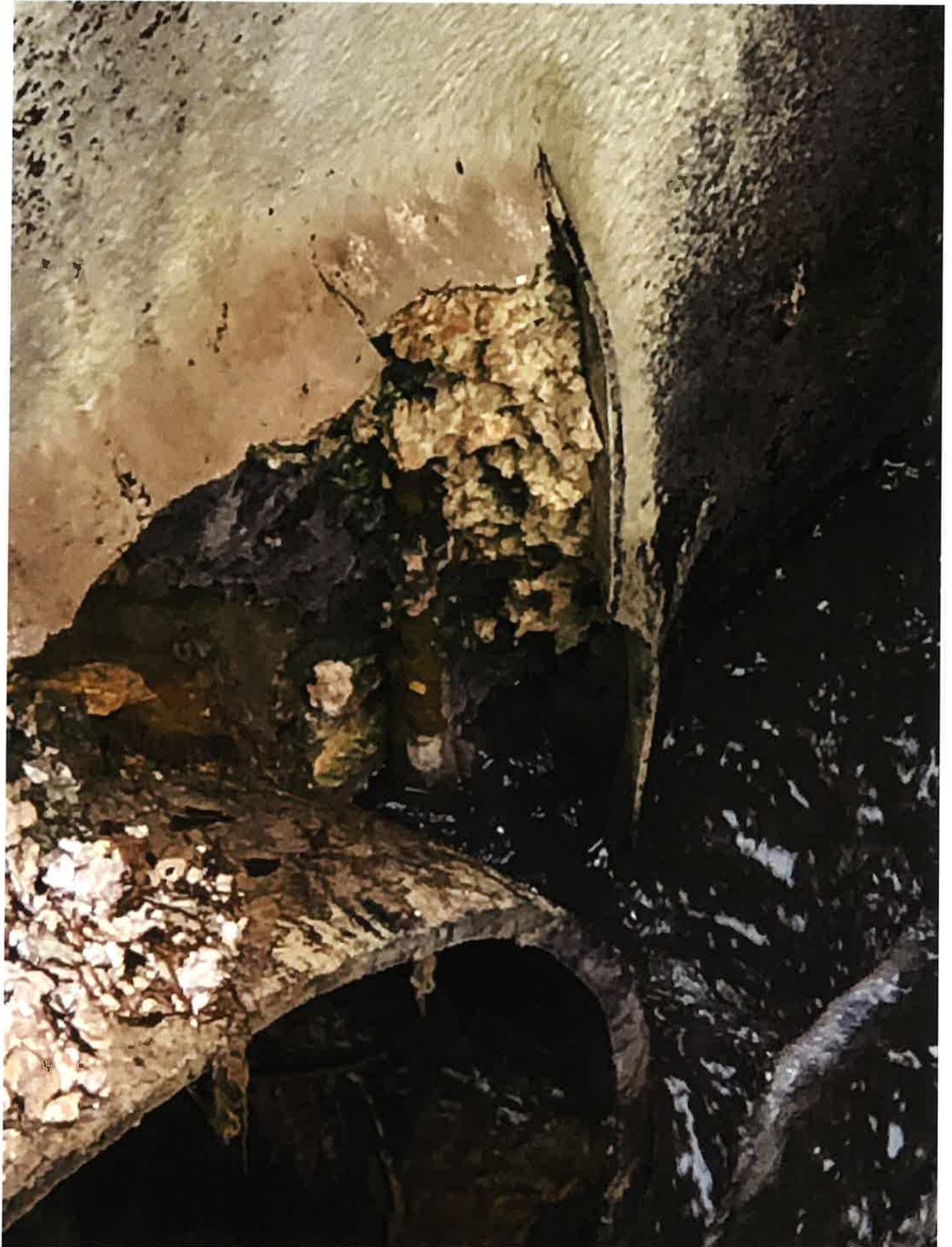




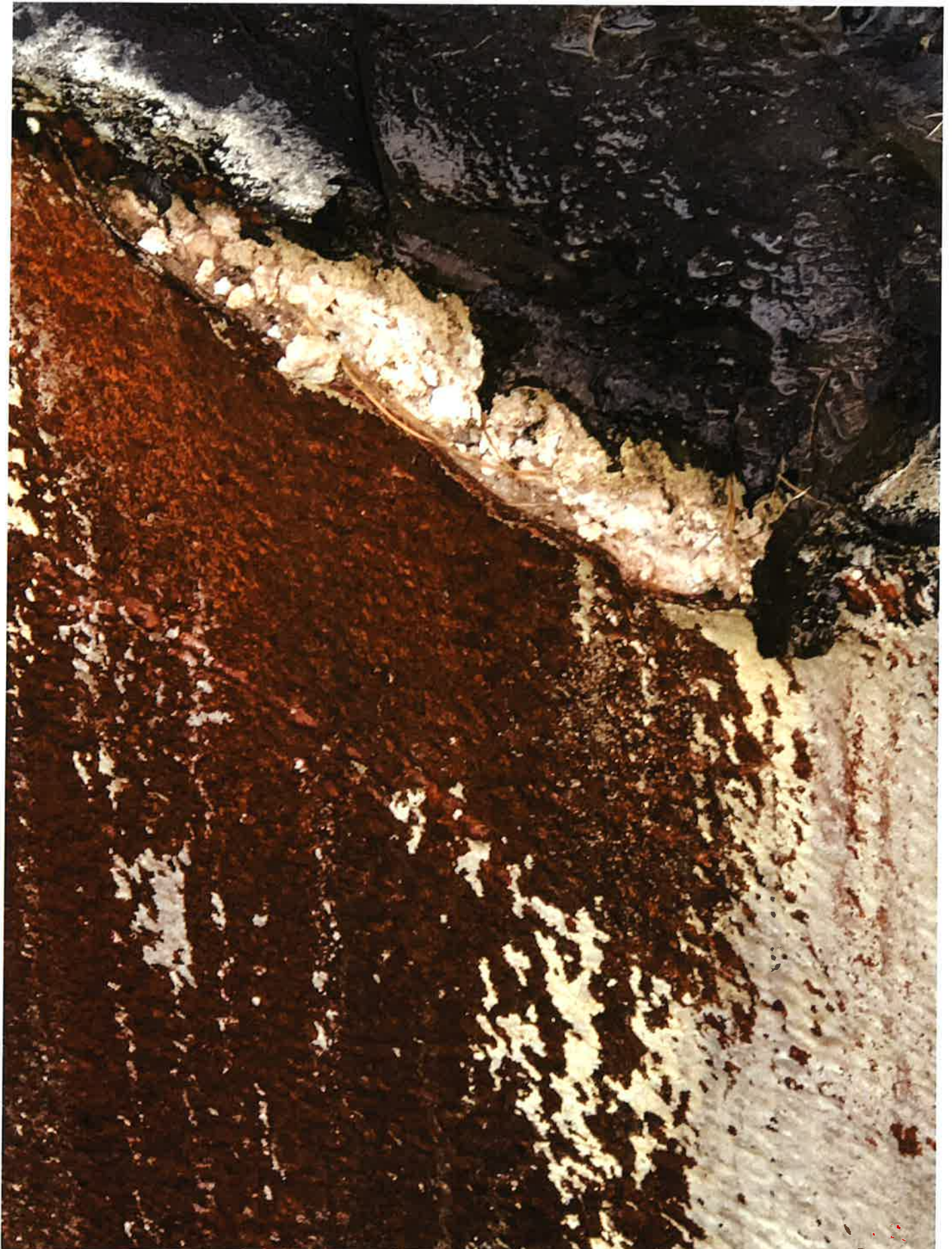












SECTION 02 41 16 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of buildings
 - 2. Abandoning in-place and removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and abandoning in-place and removing site utilities.
 - 4. Salvaging items for reuse by Owner.

- B. Related Requirements:

- 1. Section 01 10 00 "Summary" for use of the premises and phasing requirements.
 - 2. Section 01 32 00 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
 - 3. Section 02 41 19 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse and/or store. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated as salvaged, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at the project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
 - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain.
- D. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping or re-routing of utility services.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before building demolition, Owner will remove the following items:
 - a. Items to be determined in predemolition conference
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.

1.10 COORDINATION

- A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations. Comply with Section 013233 "Photographic Documentation.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
- B. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
1. Owner will arrange to shut off utilities when requested by Contractor.
 2. Arrange to shut off utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
 5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least **72** hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 01 50 00 "Temporary Facilities and Controls."
1. Protect adjacent buildings and facilities from damage due to demolition activities.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.

6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch during and for at least 30 minutes after flame-cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvaged Items:

1. All equipment shall be turned over the Owner unless noted otherwise in process drawings.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 1. Remove below-grade construction, including basements, foundation walls, and footings, to at least 12 inches below grade or to the depths indicated on the Drawings.
- E. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
- F. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.
 1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 31 20 00 "Earth Moving."
- G. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.7 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 31 20 00 "Earth Moving."
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 - 1. Clean roadways of debris caused by debris transport.
 - 2. Replace Fencing if damaged during demolition

END OF SECTION 02 41 16

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.
4. Protecting existing work to remain.
5. Cleaning soled materials that are to remain.
6. Disconnecting and capping utilities.
7. Removing debris and equipment.
8. Removal of items indicated on Drawings.
9. Salvageable items to be retained by the Owner as indicated on the Drawings and during pre-construction meeting.

B. Related Requirements:

1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

- F. Demolish: To forcefully tear down or take apart a structure.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces that might be misconstrued as damage caused by demolition

operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs or video and survey/3D scan.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. Arrange to shut off utilities with utility companies.
 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain fire watch during and for at least two hours after flame-cutting operations.
 - 6. Maintain adequate ventilation when using cutting torches.
 - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling."
- D. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- E. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site [and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and/or recycle or dispose of them according to DHEC's Structural Fill Guidelines and Permit.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 20 00 – ANCHORAGE IN CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the requirements for cast-in-place, mechanical, and adhesive anchors for concrete.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
1. Section 03 30 00 – Cast-in-Place Concrete
 2. Division 26 – Electrical
 3. Division 43 – Process Gas and Liquid Handling, Purification and Storage Equipment
 4. Division 46 – Water and Wastewater Equipment

1.3 SUBMITTALS

- A. Submit product information to the Engineer for approval in accordance with Section 013300.

PART 2 - PRODUCTS

2.1 WEDGE TYPE ANCHORS

- A. Anchors shall feature a stainless-steel split expansion ring; a threaded stud body; and integral cone expander, nut and washer.
- B. Anchor bodies smaller than 3/4 inch, excluding countersunk anchors, shall be made from AISI 316 and shall have the following minimum bolt fracture loads:

Anchor Diameter (in.)	Minimum Fracture Load (lb)
1/4	2,900
3/8	7,200
1/2	12,400
5/8	21,900

- 2.2 Anchor bodies 3/4 inch and larger, and all stainless-steel post nut anchor bodies, shall be made from AISI 316 stainless steel and shall have the following minimum mechanical properties:

Anchor Diameter (in.)	Min. Tensile Strength (ksi)	Min. Yield Strength (ksi)
$\leq 5/8$	90	76
$\geq 3/4$	76	64

- A. All nuts shall meet the dimensional requirements of ASTM F 594.
- B. Washers shall meet the dimensional requirements of ANSI B18.22.1, Type A, plain.
- C. Expansion sleeve for anchors shall be made from AISI 316. All nuts and washers shall be made from AISI 316.
- D. Anchor size and depth shall be as shown on drawings.
- E. Manufacturers:
 - 1. Trubolt as manufactured by ITW-Redhead, Inc.
 - 2. Kwik Bolt 3 as manufactured by Hilti, Inc.
 - 3. Or equal

2.3 ADHESIVE ANCHOR SYSTEM

- A. Adhesive anchor system shall consist of an injectable two-part epoxy.
- B. Application system shall be in accordance with manufacturer's recommendations. System shall keep the two components separated until application of product directly into drilled hole.
- C. System shall thoroughly blend the two parts by means of a static mixer nozzle.
- D. Injection adhesive shall be formulated to include resin and hardener to provide optimal curing speed as well as high strength and stiffness.
- E. Anchor rods shall be as shown on drawings or as specified in other sections of these specifications.
 - 1. Anchor rods shall be furnished with chamfered ends so that either end will accept a nut and washer.
 - 2. Alternately, anchor rods shall be furnished with a 45° chisel point on one end to allow for easy insertion into the adhesive-filled hole.
- F. Nuts and washers shall be provided for anchor rods in the same material as the anchor rod.
- G. Manufactures
 - 1. HIT RE 500 Epoxy Adhesive Anchor as manufactured by Hilti, Inc.

2. G5 Adhesive Anchoring System as manufactured by ITW-Redhead, Inc.
3. Or equal

2.4 CAST-IN-PLACE ANCHORS BOLTS

- A. Cast-in-place anchors shall be made of corrosion resistant material in accordance with the dimensions shown on drawings.
 1. As a minimum, provide A36 steel cast-in-place anchors.
 2. If anchor bolt size is not shown on drawings, Contractor shall provide anchors capable of providing four (4) times the load applied to the bolt.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout anchors before drilling into concrete to ensure proper placement. Following manufacturer's recommendation for spacing of anchors. Notify Engineer of conflicts between existing conditions and requirements by manufacturer.
- B. Install anchors per manufacturer's recommendations.
- C. Embedment length shall be per manufacturer's recommendations for load conditions.
- D. Check all equipment anchors after equipment has operated. Retighten any loose anchors.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 39 00 – Concrete Curing
 - 2. Division 31 – Earthwork

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, vapor-retarder installation, steel reinforcement installation, methods for achieving

specified floor and slab flatness and levelness concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For color finishes, normal weight aggregates, fiber reinforcement, reglets, waterstops, vapor retarder/barrier, and form liners.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semi-rigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- C. Material Test Reports: From a qualified testing agency.

- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer. Placing drawings indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: Acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain average concrete temperature below 90 deg F at time of placement. Maximum concrete temperature at time of placement shall be 95 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.
 2. ACI 117.
 3. ACI 350.
 4. ACI 308.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void (Carton) Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated (maximum VOC content of 350 mg/L) form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- D. Deformed-Steel Wire: ASTM A 1064/A 1064M.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

- G. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Zinc Repair Material: ASTM A 780/A 780M.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
 - a. The cement shall be low alkali, less than 0.60 percent. All cement used in concrete that will be in contact with wastewater shall have a tricalcium aluminate ($\text{Ca}_3\text{Al}_2\text{O}_6$) content of less than 8 percent.
 - b. Use one brand of cement throughout the Project unless otherwise acceptable to the Engineer.
 - 2. Fly Ash: ASTM C 618, Class F or C.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Normal weight river gravel and natural sand are acceptable for use as aggregate materials in concrete. All normal weight aggregates shall conform to ASTM C33.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
- D. Lightweight Aggregate: ASTM C 330/C 330M, 1-inch-nominal maximum aggregate size.

- E. Air-Entraining Admixture: ASTM C 260/C 260M.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- G. Water: ASTM C 94/C 94M and potable.

2.6 FIBER REINFORCEMENT

- A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.
- B. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

2.7 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Greenstreak
 - b. Williams Products, Inc.
 - c. JP Specialties, Inc.
 - d. Or approved equal.
 - 2. Profile: Ribbed with center bulb and/or Ribbed without center bulb.
 - 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricated corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BoMetals, Inc.
 - b. Sika Greenstreak.
 - c. JP Specialties, Inc.

- d. Or approved equal.
- 2. Profile: Ribbed with center bulb and/or Ribbed without center bulb.
- 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Barrier-Bac; Inteplast Group, Ltd.
 - b. JP Specialties, Inc.
 - c. Sika Greenstreak.
 - d. Or approved equal.
- D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adeka Ultra Seal/OCM, Inc.
 - b. Sika Greenstreak.
 - c. Or approved equal.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.9 FLOOR AND SLAB TREATMENTS

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Kaufman Products, Inc.
 - d. Sika Corporation.

- e. SpecChem, LLC.
 - f. Or approved equal.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. W. R. Meadows, Inc.
 - d. Or approved equal.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. L&M Construction Chemicals, Inc.
 - d. TK Products.
 - e. Or approved equal.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. L&M Construction Chemicals, Inc.
 - e. W. R. Meadows, Inc.
 - f. Or approved equal.
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

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

- a. BASF Corporation; Construction Systems.
- b. Dayton Superior.
- c. Euclid Chemical Company (The); an RPM company.
- d. L&M Construction Chemicals, Inc.
- e. W. R. Meadows, Inc.
- f. Or approved equal.

- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

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

- a. Dayton Superior.
- b. Euclid Chemical Company (The); an RPM company.
- c. L&M Construction Chemicals, Inc.
- d. W. R. Meadows, Inc.
- e. Or approved equal.

2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types I and II, nonload bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

- A. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Slag Cement: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: -As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.55.
3. Slump Limit: 3 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50
3. Slump Limit: 3 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 3 inches, plus or minus 1 inch.
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
8. Maximum W/C Ratio: 0.50.

D. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 3 inches, plus or minus 1 inch.
5. Air Content: 4 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: -4.5 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

8. Maximum W/C Ratio: 0.50.

E. Water Retaining Structures.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 535 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
6. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

F. Concrete Toppings: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Minimum Cementitious Materials Content: 600 lb/cu. yd.
3. Slump Limit: 3 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.
6. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.
7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd.

G. Building Frame Members: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

H. Building Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated in Structural General Notes at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches. 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 48 hours after placing concrete with a 72 hour pour back for adjacent pours. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated on Contractor's submitted and approved construction joint layout. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete as soon as cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricated joints in waterstops according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. N/A.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed not exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Apply to the top of exposed concrete walls and the outside exposed face to 1' below grade on all new concrete structures and new concrete additions.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces-exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces-where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after

loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Required for all water retaining structures. Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: For non-liquid retaining structures and floors only. Comply with ASTM C171. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies in writing that the curing compound does not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: For non-liquid retaining structures and floors only. Comply with ASTM C171. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least three (3) month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 WET TESTING

- A. General
 - 1. All new, water-retaining concrete structures shall be tested for water-tightness by the testing procedure described below and in accordance with ACI 350.1.
 - 2. All testing work shall be performed by the Contractor in the presence of the Engineer. The Engineer shall be notified at least five (5) days in advance of the time at which testing will be performed.
- B. Testing Water
 - 1. Water for wet testing shall be furnished by the Contractor. The source of the water must be approved by the Engineer prior to filling of the structure. As a general rule, plant effluent water is acceptable for use as testing water; however, this must be confirmed by the Engineer.
 - 2. Once testing is complete, testing water shall be disposed of in a manner acceptable to the Engineer and, unless otherwise permitted by the Engineer, shall not be allowed to enter other parts of the system.
- C. Test Equipment
 - 1. All temporary equipment needed for wet testing must be provided by the Contractor (e.g. connections between the structure to be tested and the water source, pumping equipment, metering devices, pressure or vacuum gauges, temporary flanges, valves, bulkheads, bracing, blocking, and other equipment that may be necessary to perform the testing).
 - 2. All temporary equipment shall be removed upon satisfactory completion of wet testing.
- D. Test Preparation
 - 1. Unless otherwise specified, wet testing shall be performed after installation of pipe sleeves and before placement of backfill, cleaning, disinfection, installation of process equipment, or any other activities that would hinder visual inspection of the structure during the test.
 - 2. Exposed concrete surfaces of the structure (including the floor) shall be cleaned of all foreign material and debris prior to the test. Standing water in or outside the structure that would interfere with the observation of the exposed concrete surfaces of the structure shall be removed. The concrete surfaces and concrete joints shall be thoroughly inspected for potential points of leakage, and those areas shall be repaired prior to filling the structure with water.

3. Adjacent structures having common walls shall be tested individually at different times to allow examination of the dividing walls for leaks.
4. Pipe connections or openings to structures, if not provided with drip tight valves, shall be temporarily plugged during testing. Where slide gates, sluice gates or similar devices are located, the Contractor shall provide bulkheads or the means to make them drip tight, and shall measure any leakage.
5. Filling of the structure shall not begin before the designed compressive strength of all concrete elements of the structure has been reached or before fourteen (14) days after all concrete walls or base slabs have been placed.

E. Test Procedure

1. Soaking Period: Fill the unlined concrete structure to 1 foot above the maximum operating water surface level and maintain that water level for a minimum of 72 hours, to minimize absorption of water into the concrete during testing. Identify and repair all visible leaks during the soaking period.
2. Testing Period: At the end of this soaking period, once all leaks have been repaired and the water level brought back to the required elevation, the testing period shall begin. Mark the water level with a weight suspended from a string and measure its elevation with a surveyor's level. Allow the structure to sit for a minimum of 48 hours. Following this period, identify and repair all visible leaks. Record and submit to the Engineer measurements of the water level at the beginning and end of the testing period.
3. Evaporation/Precipitation: During the testing period, suspend a bucket or pan in the structure and fill it halfway with testing water. Record and submit to the Engineer measurements of the water level at the beginning and end of the testing period, for use in accounting for any evaporation and precipitation that may have occurred during testing.

F. Leakage

1. Leakage requiring repair shall be defined as any moisture on the exterior surface of the structure, ranging from damp spots to dripping or trickling to shooting streams of water. All visible leakage is to be repaired even if magnitude is within allowable leakage.
2. Allowable leakage: For unlined tanks with a side-water depth of 25 feet or less, the net loss of water volume (including evaporation/precipitation) shall not exceed 0.1 percent in 24 hours.

G. Test Conclusion

1. If the leakage observed during testing (including evaporation/precipitation) is less than the allowable leakage, the structure shall be considered sufficiently water-tight. If it is greater than the allowable, the structure shall be drained, necessary repairs shall be made, and the structure shall be re-tested.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish blending with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.17 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a-qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M;
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

- b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 8. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 - 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
 - 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing for laboratory and office buildings.
- F. For floors required for sloping, the slope must be within 1/16" tolerances of that required in the plans.
- 3.18 PROTECTION OF LIQUID FLOOR TREATMENTS
- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 30 00

SECTION 03 41 00 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Precast structural concrete.

- B. Related Requirements:

- 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
 - 2. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
 - 3. Section 05 50 00 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

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

- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

- C. Shop Drawings:

- 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
 - 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
 - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 4. Indicate separate face and backup mixture locations and thicknesses.
 - 5. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 8. Include and locate openings larger than 10 inches. Where additional structural support is required, include header design.

9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
10. Indicate relationship of precast structural concrete units to adjacent materials.
11. Indicate estimated camber for precast floor slabs with concrete toppings.
12. Indicate shim sizes and grouting sequence.
13. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Material Certificates: For the following:
 1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Insulation.
 6. Structural-steel shapes and hollow structural sections.
- D. Material Test Reports: For aggregates, by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 - Simple AND/OR Category S2 - Complex Structural Systems.
- C. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code - Steel."
 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.6 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast structural concrete units.
- B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- D. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the design loads within limits and under conditions indicated in the plans and specifications and as required by the IBC.
 - 1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.

- a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of plus 20 to plus 100 deg F.

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497 or ASTM A 1064, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, seven-wire, low-relaxation strand.
- B. Unbonded Post-Tensioning Strand: ASTM A 416, Grade 270, uncoated, seven-wire, low-relaxation strand.
- C. Post-Tensioning Bars: ASTM A 722, uncoated high-strength steel bar.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C 618, Class N.
3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with required class. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
7. Plasticizing Admixture: ASTM C 1017, Type I.
8. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
9. Corrosion-Inhibiting Admixture: ASTM C 1582.

2.6 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36.

B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Carbon-Steel Plate: ASTM A 283, Grade C.

D. Malleable-Iron Castings: ASTM A 47, Grade 32510 or Grade 35028.

E. Carbon-Steel Castings: ASTM A 27, Grade 60-30.

F. High-Strength, Low-Alloy Structural Steel: ASTM A 572.

G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B or Grade C.

- H. Wrought Carbon-Steel Bars: ASTM A 675, Grade 65.
- I. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- J. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 OR SSPC-Paint 25 according to SSPC-PA 1.
- K. Welding Electrodes: Comply with AWS standards.
- L. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.
 - 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 - 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 - 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.8 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by

volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218.

- B. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881, of type, grade, and class to suit requirements.

2.10 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash to 20 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: For structural precast concrete with an Engineerural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.11 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Edge and Corner Treatment: Uniformly chamfered.

2.12 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 6 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A 775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

- H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- I. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
- J. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- K. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- M. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.13 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.14 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

2.15 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.
- C. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- D. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Field cutting of precast units is not permitted without approval of Engineer.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
 1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.4 FIELD QUALITY CONTROL

- A. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- B. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- D. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 41 00

SECTION 03 60 00 - GROUTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland cement grout.
2. Rapid-curing epoxy grout.
3. Nonshrink cementitious grout.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components.

1.2 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete for Buildings.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
5. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
6. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
7. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
8. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD-C621 - Non-Shrink Grout.

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information regarding grout.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and nonshrink grouts.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.5 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maximum Conditions: Do not perform grouting if temperatures exceed manufacturer's recommendations.
- C. Minimum Conditions: Maintain minimum temperature per the manufacturer before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C150, Type I and II.
- B. Water:

1. Potable.
2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.

C. Fine Aggregate:

1. Washed natural sand.
2. Gradation:
 - a. Comply with ASTM C33.
 - b. Represented by smooth granulometric curve within required limits.
3. Free from injurious amounts of organic impurities according to ASTM C40.

D. Mix:

1. Portland cement, sand, and water.
2. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 RAPID-CURING EPOXY GROUT

A. Manufacturers:

1. L&M Construction Chemicals
2. Sika Corporation
3. WR Meadows

B. Description:

1. High-strength, three-component epoxy grout formulated with thermosetting resins and inert fillers.
2. Rapid-curing, high adhesion, and resistant to ordinary chemicals, acids, and alkalis.

C. Performance and Design Criteria:

1. Compressive Strength:
 - a. 12,000 psi at seven days.
 - b. Comply with ASTM C579.
2. Minimum Tensile Strength:
 - a. 2,000 psi.
 - b. Comply with ASTM C307.

3. Coefficient of Expansion:
 - a. 30×10^{-6} inch per degree F.
 - b. Comply with ASTM C531.
4. Shrinkage:
 - a. None.
 - b. Comply with ASTM C827.

2.3 NONSHRINK CEMENTITIOUS GROUT

A. Manufacturers:

1. Euclid Chemical Company
2. Sika Corporation
3. L&M Construction Chemicals

B. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, and no chlorides.

C. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to CRD-C621 for Type D nonshrink grout:
 - a. Setting Time:
 - 1) Initial: Approximately two hours.
 - 2) Final: Approximately three hours.
 - 3) Comply with ASTM C191.
 - b. Maximum Expansion: 0.10 to 0.40 percent.
 - c. Compressive Strength:
 - 1) One-Day: 4,000 psi.
 - 2) Seven-Day: 7,000 psi.
 - 3) 28-Day: 10,000 to 10,800 psi.
 - 4) Comply with CRD-C621.

2.4 FORMWORK

- A. As specified in Section 03 30 00 – Cast-In-Place Concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping, or other similar means until sound and clean concrete surface is achieved.
- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Saturate concrete surfaces with clean water, and then remove excess water.

3.3 INSTALLATION

A. Formwork:

- 1. Construct leak proof forms anchored and shored to withstand grout pressures.
- 2. Install formwork with clearances to permit proper placement of grout.
- 3. As specified in Section 03 30 00 – Cast-In-Place Concrete.

B. Mixing:

1. Portland Cement Grout:

- a. Use proportions of two parts sand and one-part cement, measured by volume.
- b. Prepare grout with water to obtain consistency to permit placing and packing.
- c. Mix water and grout in two steps:
 - 1) Premix using approximately 2/3 of water.
 - 2) After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.
- d. Mix only quantities of grout capable of being placed within 30 minutes after mixing.

- e. Do not add additional water after grout has been mixed.
 - f. Minimum Compressive Strength: 2,400psi in 48 hours and 7,000psi in 28 days.
 - 2. Rapid-Curing Epoxy Grout:
 - a. Mix and prepare according to manufacturer instructions.
 - b. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
 - 3. Nonshrink Cementitious Grout:
 - a. Mix and prepare according to manufacturer instructions.
 - b. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.
 - 4. Mix grout components in proximity to Work area and transport mixture quickly and in manner not permitting segregation of materials.
- C. Placing of Grout:
- 1. Place grout material quickly and continuously.
 - 2. Do not use pneumatic-pressure or dry-packing methods.
 - 3. Apply grout from one side only to avoid entrapping air.
 - 4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
 - 5. Thoroughly compact final installation and eliminate air pockets.
 - 6. Do not remove leveling shims for at least 48 hours after grout has been placed.
- D. Curing:
- 1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap method.
 - 2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 3. After grout has attained its initial set, keep damp for minimum three days.

3.4 FIELD QUALITY CONTROL

- A. Inspection and Testing:
- 1. Comply with ACI 301 and as specified in Section.
 - 2. Submit proposed mix design of each class of grout to Engineer of Record for review prior to commencement of Work.
 - 3. Tests of grout components may be performed to ensure compliance with specified requirements.

END OF SECTION 03 60 00

SECTION 04 00 10 – UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. The extent of each type of masonry work is indicated on the Drawings and Schedules.
- B. This Section includes the following:
 - 1. Concrete unit masonry.
 - 2. Architectural split face CMU's are also proposed for some building construction finish as shown on the plans. The color of these units shall be selected by the OWNER from a standard manufacturer's color board; Block USA, Super Rock or approved equal.
 - 3. Standard grey color mortar at painted interior and concealed locations and custom colored mortar at exposed exterior and other locations.
 - 4. Anchors, ties, reinforcing, insulation, masonry accessories, concealed flashings, and steel lintels.
 - 5. Masonry insulation which includes rigid board insulation and foamed-in-place insulation.
 - 6. Water Repellents:
 - a. Field mixed as integral component of all exterior mortar and grout.
 - b. Field applied to all completed exterior masonry work.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 07 92 00 – Joint Sealants
 - 3. Section 09 96 00 - High-Performance Coatings

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide concrete unit masonry that develops the following installed compressive strengths (f'_m): $f'_m = 1,500$ psi.

1.4 SUBMITTALS

- A. General:
 - 1. Submit the following in accordance with Conditions of the Contract.
 - 2. Manufacturer's product data for each different masonry unit, accessory, water repellents, and other manufactured product indicated, including certifications that each item and type complies with specified requirements.

- a. Include instructions for handling, storage, installation, and protection.
- B. Shop drawings for reinforcing, if any, detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.
- C. Samples for initial verification purposes, the following:
 1. Colored masonry mortar samples to coordinate with brick color scheme selected by OWNER.
 2. Face Brick, showing full extent of colors and variations anticipated, for each standard and special shape unit.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- B. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- C. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.
- D. Single-Source Responsibility for Water Repellents: Obtain integrated applied water repellents from a single manufacturer for the entire project.
 1. Verify full compatibility with any other coatings, fluid applied waterproofing, etc., prior to application of this and other products. Notify ENGINEER in writing and in detail, of any incompatible products, prior to any application, and await ENGINEER'S written direction on how to proceed.
- E. Field-Constructed Mock-Ups: Prior to installation of unit masonry, erect sample wall panels to further verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work:
 1. Locate mock-ups on site in locations indicated or, if not indicated, as directed by ENGINEER.
 2. Build mock-ups for the following types of masonry in sizes of approximately 4 feet long by 4 feet high by full thickness, including face and backup wythes as well as accessories.
 - a. Each type of exposed unit masonry construction, utilizing mortar color and joint detail selected and/or specified.
 - b. Incorporate integral and applied water repellents, the same as required for the completed work.

- c. Incorporate for approval, an actual piece of the approved architectural precast concrete product.
 3. Notify ENGINEER one week in advance of the dates and times when mock-ups will be erected.
 4. Protect mock-ups from the elements with weather-resistant membrane.
 5. Retain and maintain mock-ups during construction in undisturbed condition as standard for judging completed unit masonry construction.
 - a. When directed, demolish and remove mock-ups from Project site.
 6. Mock-up is not required for brick pavers.
- F. Subcontractors:
1. Subcontractors shall have been established in their own firms for at least 5 verifiable years and shall have successfully completed at least 4 verifiable projects of this size, scope, and complexity. Furnish names and telephone numbers of General Contractors for each project submitted for consideration of experience requirements.

1.6 DELIVER, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.
- C. Store cementitious materials and insulation off the ground, under cover, and in dry location.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.
- F. Store water repellents in strict accordance with manufacturer's written recommendations, off of ground, under cover, and otherwise as required to protect from damage, contamination, etc.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry:
 1. During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 2. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 3. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention:
 - 1. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed, painted, and/or to receive any other coatings. Remove immediately any grout, mortar, and soil that come in contact with such masonry.
 - 2. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface, until landscaping or other improvements indicated adjacent to completed masonry work are in place.
 - 3. Protect sills, ledges, and projections from mortar droppings.
 - 4. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings, coatings, water repellents, and/or any other damage.
- D. Clean Air Space:
 - 1. Prevent grout and mortar from occurring in, bridging, forming ledges, and/or filling air space between masonry and back-up walls.
 - 2. Remove excess grout and mortar flush with back side of masonry as work progresses, using trowel, board pulled up through air space, or other effective and acceptable method(s), pre-approved by ENGINEER.
- E. Cold-Weather Construction: Comply with referenced unit masonry standard for cold-weather construction and the following:
 - 1. Do not lay masonry units that are wet or frozen.
 - 2. Remove masonry damaged by freezing conditions.
- F. Hot-Weather Construction: Comply with referenced unit masonry standard, or applicable Building Code requirements.
- G. Thoroughly clean and rinse all masonry prior to application of water repellents, water-proofing, coatings, paint, etc. Comply with written recommendations of each manufacturer of products to be applied to masonry work.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.2 CONCRETE MASONRY UNITS

- A. General:
 - 1. Comply with requirements indicated below applicable to each form of concrete masonry unit required.
 - 2. Provide special shapes where indicated and as follows:
 - a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
 - b. Square-edged units for outside corners, except where indicated as bullnose, or otherwise required.

3. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.
 4. Concrete Masonry Units:
 - a. Manufacturer's standard 16-inches long x 8-inches x 8-inches nominal dimension, unless indicated otherwise on Drawings.
 - b. Provide manufactured 1/4-notched foundation block and other preformed shapes, if any, as indicated on the Drawings.
 5. Concrete Building Brick: Standard Modular, 3-5/8-inches wide by 2-1/4-inches high by 7-5/8-inches long.
 6. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
- B. Hollow Load-Bearing Concrete Masonry Units - (CMU):
1. ASTM C 90, Grade N, Type 1.
 2. Unit Compressive Strength: Provide units with minimum average net area compressive strength of 1,900 psi.
 3. Weight Classification: Lightweight, at above-grade locations.
 4. Weight Classification: Normal weight, at below-grade locations.
- C. Concrete Building Brick:
1. ASTM C 55, Grade N, Type 1.
 2. Unit Compressive Strength: Provide units with minimum average net area compressive strength of 3,500 psi.
 3. Weight Classification: Lightweight.
- D. Pre-approved Manufacturer's, subject to compliance with requirements:
1. Alley Casetty Brick
 2. Boral Brick Company
 3. Brown's Concrete
 4. Columbus Brick Company/ Southland Brick and Block.
 5. Lojac Materials.
 6. Additional manufacturers, if any, who request approval 14-days prior to original Bid Date, and subsequently are approved.

2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement for Grout: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Masonry Cement:
1. ASTM C 91.
 2. For colored pigmented mortars use premixed colored masonry cements of formulation required to produce color to match that at existing facilities indicated.
- C. Sand: ASTM C 144.
- D. Hydrated Lime: ASTM C 207, Type S.

- E. Aggregate for Mortar:
 - 1. ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.
 - 2. White Mortar Aggregates: Natural white sand or ground white stone.
- F. Aggregate for Grout: ASTM C 404.
- G. Colored Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with record of satisfactory performance in masonry mortars.
- H. Water: Clean and potable.

2.4 REINFORCING STEEL

- A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article.
- B. Steel Reinforcing Bars: Billet steel complying with ASTM A 615.

2.5 JOINT REINFORCEMENT

- A. General:
 - 1. Provide joint reinforcement complying with requirements of referenced unit masonry standards and this article, formed from the following:
 - 2. Galvanized carbon steel wire, coating class as required by referenced unit masonry standard for application indicated, complying with ASTM A 82, hot-dipped galvanized after fabrication to comply with ASTM A 153, class B-2 coating (1.5 ounces per square foot).
- B. Description: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet in widths approximately 2 inches less than nominal width of walls and partitions, as required for full mortar embedment and mortar coverage of not less than 5/8 inch at exterior sides and not less than 1/2 inch elsewhere; with prefabricated corner and tee units, and complying with requirements indicated below, unless otherwise indicated:
 - 1. Wire Diameter for Side Rods: 09 gage
 - 2. Wire Diameter for Cross Rods: 0.1483 inch (9 gage).
 - 3. For single-wythe CMU masonry provide type as follows with single pair of side rods:
 - a. Truss design with continuous diagonal cross rods spaced not more than 16 inches o.c.
 - 4. For multi-wythe masonry provide type as follows:
 - a. Truss design with diagonal cross rods spaced not more than 16 inches o.c. and number of side rods as follows:
 - 1) Number of Side Rods for Multi-wythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches in nominal width plus one side rod for each wythe of masonry 4 inches or less in nominal width.

- C. Manufacturers: Subject to compliance with requirements, provide joint reinforcement by one of the following:
1. AA Wire Products Co.
 2. Dur-O-Wal, Inc.
 3. Heckman Building Products, Inc.
 4. Hohmann & Barnard, Inc.
 5. Masonry Reinforcing Corp. of America.
 6. National Wire Products Industries.
 7. Southern Construction Products, Inc.

2.6 TIES AND ANCHORS, GENERAL

- A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standards and of this article.
- B. Galvanized Carbon Steel Wire:
1. ASTM A 82, coating class as required by referenced unit masonry standard for application indicated.
 2. Wire Diameter: 0.1875 inch.
- C. Galvanized Steel Sheet as follows: ASTM A 366 (commercial quality) cold-rolled carbon steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, Class B2 (for unit lengths over 15 inches) and Class B3 (for unit lengths under 15 inches), for sheet metal ties and anchors exposed to the weather and not completely embedded in mortar and grout.
- D. Thickness of Steel Sheet Galvanized After Fabrication: Uncoated thickness of steel sheet hot-dip galvanized after fabrication:
1. 0.0598 inch (16 gage).
- E. Steel Plates and Bars: ASTM A 36, hot-dip galvanized to comply with ASTM A 123 or ASTM A 153, Class B3, as applicable to size and form indicated.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AA Wire Products Co.
 2. Dur-O-Wal, Inc.
 3. Heckman Building Products, Inc.
 4. Hohmann & Barnard, Inc.
 5. Masonry Reinforcing Corp. of America.
 6. National Wire Products Industries.
 7. Southern Construction Products, Inc.

2.7 ADJUSTABLE ANCHORS, FOR CONNECTING MASONRY TO STRUCTURAL FRAMEWORK

- A. General: Two-piece assemblies as described below allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it.
- B. For anchorage to new concrete, provide manufacturer's standard with dovetail anchor section formed from sheet metal and triangular-shaped wire tie section sized to extend within 1-inch of masonry face and 16-inches o.c. vertically and 24-inches o.c. horizontally (minimum).
- C. For anchorage to steel framework provide manufacturer's standard anchors with crimped 1/4-inch-diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1-inch of masonry face and 24-inches o.c. vertical (minimum):
 - 1. Wire Diameter: 0.1875 inch.

2.8 RIGID ANCHORS AT LOCATIONS INDICATED OR REQUIRED

- A. Provide straps of form and length indicated, or required (if any), fabricated from metal strips 1-1/2-inches wide by 1/4-inch thick.

2.9 ADJUSTABLE MASONRY VENEER ANCHORS FOR CONNECTING MASONRY TO METAL STUDS AND WHERE THRU-WALL JOINT REINFORCING CANNOT BE USED

- A. General: Provide 2-piece assemblies where required (if any), allowing vertical or horizontal differential movement between wall and framework parallel to plane of wall, but resisting tension and compression forces perpendicular to it; for attachment over sheathing to metal studs or masonry back-up and with the following structural performance characteristics:
 - 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in either tension or compression without deforming over, or developing play in excess of, 0.05-inch.
- B. Screw-Attached (to studs) and expansion anchor attached (to existing masonry back-up) Masonry Veneer Anchors:
 - 1. Units consisting of wire tie section and metal anchor section complying with the following requirements:
 - a. Wire Tie Shape: Z-shaped pintel.
 - b. Wire Tie Length: As required to extend 1-1/2-inches into masonry wythe of veneer face.
 - 2. Anchor Section: 16-gauge sheet metal plate, with screw hole(s) at top and outward legs bent to form leg to bridge insulation and abut studs, or masonry; of overall size as required for intended application.
- C. Steel Drill Screws for Steel Studs or Masonry: ASTM C 954 except manufactured with hex washer head and neoprene washer, #10 diameter by length required to penetrate steel stud flange by not less than 3-exposed threads, and masonry but not less than 1-inch, and with corrosion protective coating; as recommended by manufacturer for the intended use.

- D. Products: Subject to compliance with requirements, provide products of one of the following manufacturers:
 - 1. Jim Taylor, Inc./Ty-wal.
 - 2. National Wire Products Industries/Pos-i-tie.
 - 3. Elco Industries/Tapcon
 - 4. Hilti Corporation
 - 5. Rawl Plug Co., Inc. (Zamac Nail-in anchor system, additional acceptable fasteners for masonry veneer and some other anchors).
 - E. Galvanize all components.
- 2.10 MISCELLANEOUS ANCHORS AT LOCATIONS INDICATED OR AS REQUIRED BY PROJECT CONDITIONS
- A. Unit Type Masonry Inserts new in Concrete: Cast iron or malleable iron inserts of type and size indicated.
 - B. Dovetail Slots for New Concrete: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336-inch (22-gage) galvanized sheet metal.
 - C. Anchor Bolts: Steel bolts complying with A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations, as indicated on the Drawings, or if not indicated, as required for the intended use:
 - 1. Headed bolts.
 - 2. Nonheaded bolts, straight.
 - 3. Nonheaded bolts, bent in manner indicated.
- 2.11 POST-INSTALLED ANCHORS, WHERE INDICATED OR AS REQUIRED
- A. Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.
 - 1. Type: Expansion anchors.
 - 2. Material: Zinc-plated carbon steel, hot-dipped galvanized after fabrication, or Zamac, or other non-corrosive or coated material in compliance with requirements and submitted for prior approval.
 - 3. For post-installed anchors in grouted concrete masonry units: Capability to sustain, without failure, a load equal to 6-times loads imposed by masonry.
- 2.12 EMBEDDED FLASHING MATERIALS
- A. Rubberized Asphalt and Cross-Laminated Polyethylene Film Composite Sheet Flashing:
 - 1. Flexible sheet flashings especially formulated from rubberized asphalt and composite with materials, to remain flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below:
 - a. Thickness: 40-mils.

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2. Product/Manufacturer: "Perm-A-Barrier," as manufactured by W. R. Grace & Co., or pre-approved equivalent submitted at least 14-days prior to original Bid Date and subsequently approved, including mastic, and where required companion surface conditioner product, and all other materials and components required.
 3. Application: Use where flashing is fully concealed in masonry, including in part, wall flashing, below parapets, wall caps and sills, at lintels, above grade weeps at base of exterior walls, etc.
- B. Adhesive for Flashings: Bituthene mastic, except when other type recommended by manufacturer of flashing material for use indicated.

2.13 MISCELLANEOUS MASONRY ACCESSORIES

- A. Nonmetallic Expansion Joint Strips: Pre-molded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated, formulated from the following material:
1. Flexible Cellular Neoprene.
- B. Preformed Control Joint Gaskets:
1. Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated, or if not indicated, T-shape (or other special shapes required by project conditions to fit inside sash block, and of depth through joint to allow proper sealant application with only one backer rod.
 2. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation 2AA-805.
- C. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep Holes, provide the following: Cotton sash cord; 3/8-inch outside diameter by length(s) as required to overlap cord 2-inches past adjacent weep hole at bottom of air space at interior wall cavity, extend through exterior wythe(s), and 4-inches on exterior side - until water repellent is applied and excess is trimmed flush with raked mortar joint at flashing.
1. Wet cord prior to embedding in mortar.

2.14 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2-cup dry measure) and laundry detergent (1/2-cup dry measure) dissolved in one gallon of water.

2.15 MORTAR AND GROUT MIXES

- A. General:
1. Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

2. Do not use calcium chloride in mortar or grout.

- B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Mortar for Unit Masonry:
1. Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless indicated otherwise.
 2. Use type M mortar for masonry below grade and in contact with earth, and where indicated.
 3. Use type S mortar for reinforced masonry and where indicated.
 4. Use type S mortar for exterior, above-grade load-bearing and non-loadbearing walls and parapet walls; for interior load-bearing walls; for interior non-loadbearing partitions, and for other applications where another type is not indicated.
- D. Mortar Colors: To coordinate with brick and block veneer color selections.
- E. Grout for Unit Masonry:
1. Comply with ASTM C 476 for grout for use in construction of reinforced and nonreinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement which will completely fill all spaces intended to receive grout.
 2. Use fine grout in grout spaces less than two inches (2") in horizontal direction, unless otherwise indicated.
 3. Use coarse grout in grout spaces two inches (2") or more in least horizontal dimension, unless otherwise indicated.

2.16 INSULATION FOR MASONRY WALLS

- A. General:
1. Provide insulation products below at exterior masonry walls enclosing building with face brick and CMU back-up walls, and elsewhere as indicated.
 2. Provide Loose Granular Insulation at all possible locations, interior and exterior, as indicated below.
- B. Insulation
1. Foamed-in-place Foam Insulation System
 - a. Pre-approved Equivalent To:
 - 1) "Core Foam Masonry Foam Insulation", as manufactured by cfiFOAM, Inc.; Knoxville, TN; Phone: 1-800-656-3626; or
 - 2) "Core-Fill 500", as manufactured by Tailored Chemical Products, Inc.; Hickory, N.C.; Phone: 1-800-627-1687; or
 - 3) "R501", as manufactured by PolyMaster, Inc.; Knoxville, TN.; Phone: 1-800-580-3626 (Representative: Southeast Construction Services, LLC; Dothan, AL.; Phone: (334) 673-0622).
 - b. Where foam insulation may occur at exterior and other double-wythe walls, install from cavity side, and conceal drilled holes at all locations where possible.

- c. Holes for installation of foam insulation shall occur in and be no larger than typical 3/8-inch mortar joints. Patches for holes shall be for the full depth of mortar removed by drilling, and shall match adjacent mortar joint tooling and texture.
- 2. Loose Granular Vermiculite Insulation
 - a. Expanded vermiculite complying with ASTM C 516, Type II (surface-treated for water repellency and limited moisture absorption), Grade 3 (Fine); R-Value of 2.3 BTU/(HR x SF x °F) at 75°F.
 - b. Location: All hollow CMU walls around exterior and all interior rooms, and at 2-hour and 4-hour fire-rated walls, except where cells are required to be filled with grout or concrete.

2.17 WATER REPELLENT

- A. Provide from a manufacturer and by an applicator complying with experience requirements in "Special Conditions," as follows: 40% Silane Solution in alcohol carrier.
- B. Submit for approval prior to application.
- C. Application rate not to exceed 125 SF per gallon.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of unit masonry, if any.
- B. Examine rough-in and built-in construction to verify actual locations of other or related work, prior to installation.
- C. Do not proceed until any unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with referenced unit masonry standards and other requirements indicated, applicable to each type of installation included in Project.
- B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
- C. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry

between chase or recess and jamb of openings and between adjacent chases and recesses.

- D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
- E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.
 - 1. Use dry cutting saws to cut concrete masonry units.
- F. Do not wet concrete masonry units.
- G. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- H. Wet sash cord weeps prior to embedding in mortar, so it will not draw water out of mortar.

3.3 CONSTRUCTION TOLERANCES – REQUIRED FOR ACCEPTANCE

- A. Comply with construction tolerances of referenced unit masonry standards.
- B. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4-inches in 10-feet, or 3/8-inches in a story height not to exceed 20-feet, nor 1/2-inches in 40-feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4-inches in any story or 20-feet maximum, nor 1/2-inch in 40-feet or more. For vertical alignment of head joints do not exceed plus or minus 1/4-inches in 10-feet, 1/2-inch maximum.
- C. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4-inches in any bay or 20-feet maximum, nor 1/2-inches in 40' or more. For top surface of bearing walls do not exceed 1/8-inches between adjacent floor elements in 10' or 1/16" within width of a single unit.
- D. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- E. Variation in Cross Sectional Dimensions: Do not exceed bed joint thickness indicated by more than plus or minus 1/8". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and

offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

- B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
 - 1. Running bond, unless otherwise indicated on Drawings.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work: In each course, rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-In Work:
 - 1. As construction progresses, build-in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
 - 2. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 3. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of zinc expanded metal lath in the joint below and rod mortar or grout into core.
 - 4. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 - 1. With full mortar coverage on horizontal and vertical face shells and cross webs.
 - 2. Bed webs in mortar in starting course on footings and in all courses of walls, piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- B. Cut joints flush for masonry walls to be concealed or to be covered by base, crown moulding, and/or other materials, unless otherwise indicated.
- C. Tool all joints in exposed exterior work as follows:
 - 1. Tooled slightly concave with a tool of at least 50% but no more than 100% larger than joint width, at CMU and concealed masonry.
- D. Tool all joints in all interior work as follows:
 - 1. Tooled same as for CMU and concealed masonry at exterior.

2. Struck smooth behind base and crown mouldings.

- E. Maintain joint widths of 3/8 inch, except for minor variations required to maintain bond alignment, or as otherwise required to align with or mach adjacent existing work.
- F. Collar Joints: After each coarse is laid, fill vertical longitudinal joint between wythes solidly with mortar, for the following work:
 - 1. Exterior walls, except where clear air space above flashing is indicated.
 - 2. Interior bearing walls.

3.6 STRUCTURAL BONDING OF MULTI-WYTHER MASONRY

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes, at 16 inches o.c. vertically (maximum) at running bond and 8 inches o.c. (maximum) at stacked bond.
- B. Corners:
 - 1. Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
 - 2. Provide continuity with horizontal joint reinforcement at corners using prefabricated "L" units, in addition to masonry bonding.
- C. Intersecting and Abutting Walls:
 - 1. Unless vertical expansion or control joints are shown or necessary at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
 - 2. Provide individual metal ties to columns and stud walls, at 16 inches o.c. vertically (maximum).
 - a. Provide additional anchors within 1'-0" of openings and at intervals around perimeter not exceeding 3'-0" o.c.
 - 3. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.
 - 4. Provide continuous dovetail slots, with anchors at 16 inches o.c. maximum vertically and 24 inches o.c., at new concrete back-up walls, columns, etc.

3.7 MASONRY CAVITY WALL AND MASONRY –CELL INSULATION

- A. On units of rigid insulation install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face. Fit courses of insulation between walls ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry at other construction as shown.
 - 1. Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.
- B. Pour granular insulation into cavities as indicated, to completely fill void spaces. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close ports after complete coverage has been confirmed. Limit fall of insulation to scaffold section height, but not to exceed 6'-0".
 - 1. Provide granular loose-fill insulation at the following locations:

- a. In cells of all hollow CMU indicated in Paragraph 2.17 above, except cells which are required to be filled with concrete or grout.

3.8 CAVITIES/AIR SPACES

- A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.
 1. Where not possible and at metal studs, tie exterior wythe to backup with individual metal ties spaced not more than 16 inches o.c. vertically and 24" o.c. horizontally. Stagger alternate courses.
- B. Provide weepholes in exterior wythe of new cavity walls, located immediately above ledges and flashing, spaced 32 inches o.c. unless otherwise indicated.
- C. Tie exterior wythe to backup and multi-wythe walls with continuous horizontal joint reinforcing at 16 inches o.c. vertically.

3.9 HORIZONTAL JOINT REINFORCEMENT

- A. General: Provide continuous horizontal joint reinforcement as indicated and as required by Code, but not more than 16 inches o.c. vertically at running bond and 8 inches o.c. vertically at stacked bond. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
- D. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints.

3.10 ANCHORING MASONRY WORK

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 2. Anchor masonry to structural members with flexible anchors which allow 4-way movement embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally.

B. Anchor single-wythe masonry veneer to studs with masonry veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to studs with 2 metal fasteners of type indicated.
2. Embed tie section in masonry joints. Provide not less than 1-inch air space between back of masonry veneer wythe and face of sheathing.
3. Locate anchor section relative to course in which tie section is embedded to allow maximum vertical differential movement of tie up and down.
4. Space anchors as indicated but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 1'-0" of openings and at intervals around perimeter not exceeding 3'-0" o.c.

3.11 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where existing in floor slabs, walls, and roof, and as required (or otherwise indicated). Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows: Install preformed control joint gaskets designed to fit standard sash block. Fill recesses with backer rod and flexible sealant, as specified in Section 079200 - "Joint Sealers."
- C. Where not otherwise indicated, provide control joints at straight runs of masonry walls, not to exceed 30'-0" o.c. at exterior walls and 40'-0" o.c. at interior walls. Obtain prior approval from Architect for specific locations.

3.12 LINTELS

- A. Install galvanized steel lintels where indicated.
- B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.
 1. For hollow concrete masonry unit walls, use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.
 1. Unless indicated otherwise, fill jamb cells with concrete, from structure below up to bottom of lintel bearing, 8 inches wide x wall thickness minimum.

3.13 FLASING/WEEP HOLES

- A. General: Install embedded concealed flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in exterior walls, and where indicated.
- B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape, as recommended by flashing manufacturer before covering with mortar.
 - 1. Where indicated or required by manufacturer, provide continuous seal at top edge, using their recommended materials.
- C. Install flashings as follows:
 - 1. At lintels and shelf angles, extend flashing a minimum of 4 inches (nominal) into masonry at exterior end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches, and seal to the interior face of the back-up wall.
 - 2. At heads and sills, extend flashing as specified above unless otherwise indicated but turn up ends not less than 2 inches to form a pan.
 - 3. Cut off flashing 1/2-inch from exterior face of wall and rake joint in accordance with flashing manufacturer's requirements.
 - 4. Comply with manufacturer's instructions and recommendations.
 - 5. Seal top edge of flashing with manufacturer's recommended product.
- D. Install weep holes, in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:
 - 1. Form weep holes with product specified in 2.14.
 - 2. Space weep holes 32 inches o.c., unless otherwise indicated.
 - 3. Wet cotton sash cord prior to embedding in mortar.

3.14 INSTALLATION OF REINFORCED UNIT MASONRY

- A. General: Install reinforced unit masonry to comply with requirements of referenced unit masonry standards, and as indicated on the Drawings.

3.15 REPARING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final Cleaning - After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave 1/2 panel un-cleaned for comparison purposes. Obtain ENGINEER'S approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean brick by means of bucket and brush hand-cleaning method described in BIA "Technical Note No. 20 Revised", to clean brick masonry made of clay or shale, except use detergent as the masonry cleaner.
6. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.
 - a. Comply with masonry manufacturer's instructions.

3.16 WATER REPELLENTS

- A. Apply water repellents to all exterior masonry after thorough cleaning and rinsing, prior to any backfill or any other concealment.
- B. Install in strict accordance with manufacturer's written recommendations.

3.17 PROTECTIONS

- A. Trim excess sash cord flush with cured mortar joint at exterior side of walls.
- B. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION 04 00 10

SECTION 05 40 00 - ALUMINUM HANDRAIL

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment and materials required to furnish and install aluminum component handrail including all fittings, anchors, bases and accessories, as required by the Contract Documents.
- B. All guardrails shall be furnished with a toe board, except where concrete curbs are shown (if any).
- C. This section shall be used for all handrail except in areas where stairs and handrail are congruent as specified in Section 05 52 13.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 05 50 00 – Metal Fabrications
 - 3. Section 05 52 13 – Pipe and Tube Railings

1.3 SUBMITTALS

- A. Submit complete shop drawings and product data in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit structural calculations, including anchorages.

1.4 STORAGE AND PROTECTION

- A. Handrails shall be properly packaged to prevent scratching and denting during shipment, storage and erection. Maintain protective wrapping until project is completed.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Component aluminum handrail system shall be designed and constructed in strict compliance with the requirements of OSHA and the International Building Code.
- B. Guardrails shall be designed to withstand a uniform horizontal load of 50 pounds per foot with a simultaneous vertical load of 100 pounds per foot applied to the top rail.
- C. Handrail shall be designed to withstand a uniform horizontal load of 50 pounds per foot applied to the top rail.
- D. In addition, guardrails, handrails shall be designed to withstand a concentrated load of 200 pounds applied in any direction, at any point on the railing system.

2.2 ACCEPTABLE PRODUCTS/MANUFACTURERS

- A. Component aluminum handrail system shall be "TUFrail" by Thompson Fabricating - B'ham., AL., "Interna-Rail" by Hollaender Corp. - Cinn., Ohio, or equal by Alumagard - Denver, CO.

2.3 MATERIAL AND CONSTRUCTION

- A. Handrail shall be the product of a company normally engaged in the manufacture of pipe railing. Railing shall be shop assembled in lengths not to exceed 24 feet for field erection.
- B. Post spacing shall be a maximum of 6'-0". Posts and rails shall be a minimum of 1 1/2" schedule 40 aluminum pipe, alloy 6063-T6 or 6105-T5, ASTM B-429 or B-221.
- C. Handrail shall be made of pipe and fittings mechanically fastened together with stainless steel hardware. Handrail systems which use fittings that are glued or pop-riveted will not be acceptable.
- D. Toe board shall conform to OSHA standards. Toe board shall be a minimum of 4" high and shall attach to the post using clamps which will allow for expansion and contraction between posts. Toe board shall be set 1/4" above the walking surface.
- E. Wedge anchors shall be spaced 10d apart and 5d edge distance for no reduction in pullout strength. A safety factor of 4 shall be used on pullout values published by the manufacturer. Wedge anchors shall be type 304 stainless steel.
- F. Openings in the railing shall guarded by a self-closing gate (OSHA 1910.23). Safety chains are not acceptable.
- G. All handrail and components shall be clear anodized per Aluminum Association M10C22A41 (215-R1). The pipe shall be plastic wrapped to protect the finish.

- H. All aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bituminous paint, mylar isolators or other approved material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Field fabrication of the railing system is not permitted.
- B. Set handrails plumb within 1/8" of vertical and align horizontally to within 1/8" in 12 feet.
- C. Install wedge anchors to proper depth to develop full pullout and shear values. Check all fasteners and bolts in base connections and splices for tightness.
- D. Adequate provisions for expansion and contraction shall be incorporated into the rail. Expansion joints shall be placed at 60-foot intervals and at all concrete expansion joints.
- E. Toe boards shall be shipped loose and attached to the handrail in the field. Attachment to the posts shall be made with clamps which will allow for expansion and contraction while maintaining a straight line.
- F. All defective, damaged or otherwise improperly installed handrail shall be removed and replaced with material which complies with this section at no additional cost to the Owner.
- G. Following installation, aluminum handrail shall be cleaned with a mild soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used.

END OF SECTION 05 40 00

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work described in this section includes metal fabrications, which include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere. Types of work in this section includes metal fabrications for:
1. Rough hardware.
 2. Loose bearing and leveling plates.
 3. Loose steel lintels.
 4. Miscellaneous framing and supports.
 5. Guard Posts (bollards)
 6. Stair Treads and Nosings

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
1. Section 03 20 00 – Anchorage in Concrete

1.3 QUALITY ASSURANCE

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products and grout.
- B. Shop Drawings: Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plans, elevations and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor and bolt installation by others. Where materials or fabrications are indicated to comply with certain requirements for design loadings include structural computations, material properties and other information needed for structural analysis.
- C. Samples: Submit representative samples of materials and finished products as may be requested by ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
- B. Ferrous Metals
1. Steel Plates, Shapes and Bars: ASTM A 36.
 2. Steel Bar Grating: ASTM A 569 or ASTM A 36
 3. Steel Tubing: Cold formed, ASTM A 500; or hot rolled, ASTM A 501.
 4. Structural Steel Sheet: Hot-rolled, ASTM A 570; or cold-rolled ASTM A 611, Class 1; of grade required for design loading.
 5. Galvanized Structural Sheet Steel: ASTM A 446, of grade required for design loading. Coating designation as indicated, or if not indicated, G90.
 6. Steel Pipe: ASTM A 53; Type and grade (If applicable) as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (schedule 40), unless otherwise indicated.
 7. Gray Iron Castings: ASTM A 48, Class 30.
 8. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.
 9. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
 10. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.
- C. Non-Ferrous Metals
1. Aluminum Drawn Seamless Tube: ASTM B 483, 6063-T832.
 2. Aluminum Castings: ASTM B 26, 356.0-T6.
 3. Aluminum Plate and Sheet: ASTM B 209, 6061-T6
- D. Grout: Non-Shrink Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with CE-CRD-C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
- E. Fasteners
1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
- F. Paint:
1. Metal Primer Paint: Southern Coating "Heavy Duty RIP Primer 1-0900", Tnemec "10-99 Primer", or approved equal.
 2. Primer selected must be compatible with finish coats of paint.
 3. Galvanizing Repair Paint: High zinc dust content paint for re-galvanizing welds in galvanized steel, complying with Military Specifications MIL-P-21035 (Ships), or SSPC-Paint-20.

2.2 STAIR TREADS AND NOSINGS

A. MATERIALS

1. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy extruded bars, rods, wire, shapes and tubes.

B. TYPE

1. SINGLE PART BAR ABRASIVE, FULL ABRASIVE STAIR TREADS AND NOSINGS
 - a. Base and Nosing: Extruded aluminum type 6063-T5, mill finish
 - b. Nosing Types for concrete pour, steel pan, wood and sloped stairs and risers.
 - c. Tread abrasive filler: Bar type ribbed
 - 1) Includes virgin grain Aluminum Oxide and/or Silicon Carbide. Binder is a UV protected 2-part epoxy continuous throughout entire tread. Color shall extend uniformly throughout filler. Black is standard color unless other specified.
 - 2) Black is the standard abrasive fill color unless other specified

- C. Bar Abrasive width [1.375", 1.875", 3", 4"] Full Abrasive width [2", 2.125", 2.25", 3", 3.125", 4", 4.125"]

- D. Installation fastening type: [Extruded anchors] [Drilled countersunk holes]

- E. Acceptable Product Series: STSB-C3E

- F. Acceptable Manufacturers:

1. Victory Treads, LLC
2. OR APPROVED EQUAL

PART 3 - EXECUTION

3.1 FABRICATION, GENERAL

A. Workmanship

1. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
3. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
4. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown, or if not shown, Phillips flat-head (countersunk) screws or bolts.

5. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
 6. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.
 7. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.
- B. Galvanizing: Provide a zinc coating for those items shown or specified to be galvanized, as follows:
1. ASTM A 153 for galvanizing iron and steel hardware.
 2. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8" thick and heavier.
 3. ASTM A 386 for galvanizing assembled steel products.
- C. Shop Painting
1. Apply shop primer to surfaces of metal fabrications except those which are galvanized or as indicated to be embedded in concrete or masonry, unless otherwise indicated, and in compliance with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
 2. Stripe paint all edges, corners, crevices, bolts, welds and sharp edges.
- D. Surface Preparation
1. Prepare ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specification and environmental exposure conditions of installed metal fabrications:
 - a. Exterior (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning."
 - b. Interiors (SSPC Zone 1A): SSPC-SP3 "Power Tool Cleaning."

3.2 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures.
- B. Fabricate items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

3.3 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

3.4 LOOSE STEEL LINTELS

- A. Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8" bearing at each side of openings, unless otherwise shown.

1. Galvanize all loose steel lintels in exterior walls.

3.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required to complete work.
- B. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- C. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed. Except as otherwise shown, space anchors 24" o.c. and provide minimum anchor units of 1-1/4" x 1/4" x 8" steel straps.
- D. Galvanize exterior miscellaneous frames and supports.

3.6 PREPARATION

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
- B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete insets, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.7 INSTALLATION

- A. General:
 1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
 2. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
 3. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip-galvanized after fabrication, and are intended for bolted or screwed field connections.

- B. Field Welding: Comply with AWS Code for procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- C. Setting Loose Plates:
 - 1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - 2. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout. Use non-metallic, non-shrink grout.
 - 3. Pack grout solidly between bearing surfaces and plates to insure that no voids remain.
- D. Stair Treads
 - 1. Install stair treads and nosing's in accordance with the governing regulations, the industry standards applicable to the work and the manufacturer's written instructions
 - 2. Work shall be aligned plumb, level and where required, flush with adjacent surfaced and rigidly anchored to the substrate.

3.8 ADJUST AND CLEAN

- A. Touch up Painting
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same materials as used for shop painting.
 - 2. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. For Galvanized Surfaces: Clean field welds, bolted connections and abraded areas and apply galvanized repair paint to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 51 19 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes industrial-type, straight-run stairs with aluminum-grating treads and railings attached to aluminum grating stairs.

1.3 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal grating stairs and the following:
 - 1. Grout.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments.
- C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.

3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to **L/360**.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Aluminum Plates, Shapes, and Bars: ASTM A 429, Alloy 6063-T5.
- C. Steel Bars for Grating Treads: Conform to requirements of section 055313-Bar
- D. Corrugated Nosings: Extruded aluminum, with an integral corrugated non-slip finish.

2.3 FASTENERS

- A. General: Provide type 316 stainless steel fasteners with coating complying with ASTM F 593. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 1. Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.
- B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.

- B. Form exposed work with accurate angles and surfaces and straight edges.
- C. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.
- D. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 ALUMINUM-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
 - 1. Fabricate stringers of structural aluminum channels.
 - a. Provide closures for exposed ends of channel stringers.
 - 2. Construct platforms of aluminum channel headers and miscellaneous framing members as needed to comply with performance requirements.
 - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
 - 1. Fabricate treads and platforms from pressure-locked aluminum grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
 - 2. Fabricate treads and platforms from pressure-locked steel grating with openings in gratings no more than 1/2 inch in least dimension.
 - 3. Surface: Serrated.
 - 4. Finish: Mill finish.
 - 5. Fabricate grating treads with non-slip nosing and with aluminum angle or aluminum plate carrier at each end for stringer connections. Secure treads to stringers with bolts.
 - 6. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Mechanically attach grating to platform framing.

2.7 STAIR RAILINGS

- A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.
- B. Set stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonmetallic, nonshrink grout unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

END OF SECTION 05 51 19

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Stainless handrails for interior installation located in Council Chamber at stairs and ramps.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- B. Thermal Movements: Design handrails and railings that allow for thermal movements resulting from specified maximum change (range) in ambient and surface temperatures without buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120-deg F, ambient; 180-deg F, material surfaces.
 - 2. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1.4 SUBMITTALS

- A. Product Data: Submit data for the following:

1. Railing brackets.
 2. Grout and anchoring cement products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Show anchorage and accessory items.
 2. Indicate that the qualified professional engineer responsible for preparing structural analysis has reviewed shop drawings.
- C. Structural Analysis: Submit for railings and handrails indicating compliance with specified performance requirements, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Samples:
1. Railing: Submit 6-inch sections of each distinctly different linear railing member, including handrails, top rails and posts.
 2. Fittings and brackets: Submit for each type required for installation.
- E. Qualification Data: Submit for qualified professional engineer and for fabricator to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified. (Submit for Architect's information only.)
- F. Welding Certificates: Submit welders' certificates for personnel performing the work complying with qualification requirements. Certificates shall be current within the previous twelve (12) months. (Submit for Architect's information only.)
- G. Paint Compatibility Certificates: Submit written approval from manufacturers of topcoats to be applied over shop primers certifying that shop primers are compatible with topcoat material. (Submit for Architect's information only.)

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Fabricator shall have minimum Five (5) years experience in the successful production and installation of railings and handrails of similar design and complexity as indicated for this Project.
- B. Professional Engineer Qualifications: A professional engineer legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated for the installation of railings and handrails similar in material, design, and extent to those required for this Project with a record of successful in-service performance. Engineer's service shall include review of shop drawings.
- C. Welder Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
- D. Source Limitations: Obtain railings from a single source.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site undamaged and protected.
- B. Store materials above ground in a clean, dry location and protected to avoid damages. Cover with waterproof covering with provisions for adequate air circulation.
- C. Handle materials, exercising particular care to prevent damage to prefinished components; keep handling to a minimum.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating handrails and railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METAL QUALITY

- A. Metal Surface Appearance: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 STAINLESS STEEL

- A. Stainless Steel Tubing: ASTM A 554, Grade MT 304.
- B. Handrail Brackets, Flanges, and Anchors: Cast or formed stainless steel of same finish as supported rails unless otherwise indicated. Brackets shall be sized to provide minimum 1-

1/2 inch clearance from inside face of handrail to finished wall surface when installed in place. Provide wall brackets comparable to Julius Blum & Company, Inc., model no. 275.

2.3 FASTENERS AND ANCHORS

A. Fasteners:

1. Fastener Types:

- a. For Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- b. For Interconnecting Railing Components:
 - 1) Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2) Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

2. Fastener Materials and Finishes: Type 304 or Type 316 stainless-steel fasteners.

- ### B. Post-Installed Anchors:
- Torque-controlled expansion anchors or chemical anchors with alloy Group 1 or Group 2 stainless-steel bolts meeting ASTM F 593, and nuts meeting ASTM F 594. Anchors shall be capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

- ### A. Welding Rods and Bare Electrodes:
- Select according to AWS specifications for metal alloy welded. Provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- ### B. Shop Primers:
- Provide primers that comply with Division 9 Section - "Painting" for type metal surfaces to be painted.
- ### C. Bituminous Paint:
- Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- ### D. Anchoring Cement:
- Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound designed for exterior applications.

1. Water-Resistant Product: Product shall be of formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
2. Compressive Strength: 7000 psi (48.2MPa), minimum, at 28-days when tested according to ASTM C109.

2.5 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly.
 1. Disassemble units only as necessary for shipping and handling limitations.
 2. Clearly mark units for reassembly and coordinated installation.
 3. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32-inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Fabricate railings with welded connections unless otherwise indicated. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 1. Weld all around at connections, including at fittings.
 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 3. Obtain fusion without undercut or overlap.
 4. Remove flux immediately.
 5. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Form changes in direction by radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
- I. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire

bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4-inch or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- N. Fabricate railing posts for setting in concrete with sleeved, formed or core-drilled holes used as method for anchorage.
- O. Stainless Steel Handrails: Fabricate from specified stainless steel tubing material for mounting to wall construction at stairs and ramps located in Council Chamber.

2.6 FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples.
 - 1. Noticeable variations in the same piece are unacceptable.
 - 2. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
- B. Stainless Steel Railing Finish: No. 6 dull satin finish (240-grit polished finish).
 - 1. Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 3. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16-inch in 3-feet.
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4-inch in 12-feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections as specified for fabrication whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2-inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6-inches of post.

3.3 ANCHORING POSTS

- A. Anchor posts to concrete construction by either of the following methods specified:
1. Preset Pipe Sleeves: Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement as specified.
 2. Formed or Core-Drilled Holes: Form or core-drill holes not less than 5-inches deep and 3/4-inch larger than outside diameter (OD) of post for installing posts in concrete. After posts are inserted in holes, fill annular space between post and concrete with anchoring cement as specified.
- B. Anchoring Cement Installation: Mix and place to comply with anchoring material manufacturer's written instructions.
1. Clean holes of loose material, insert posts, and fill annular space between post and concrete with prepared anchoring cement.
 2. Fill annular space leaving 1/8-inch approximate recess for capping with sealant.
 3. Caulk around joint of post set in anchoring cement with urethane sealant specified in Division 7 - Section - "Joint Sealants." Apply sealant with 1/8-inch buildup and troweled smooth to form slope away from post.

- C. Anchor posts attached to metal substrates with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members. Weld flanges to post and bolt to metal supporting surfaces.

3.4 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction with concealed anchors and connected to railing ends using nonwelded connections.
- B. Attach handrails to wall with wall brackets.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 2. Install brackets to provide not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel-framed partitions, use either of the following methods:
 - a. Attach with self-tapping screws or through-bolts fastened to steel framing or to concealed heavy gauge steel plate reinforcements.
 - b. Attach with hanger bolts or lag bolts set in fire-retardant-treated wood blocking located between studs. Coordinate location of blocking members with stud installation.

3.5 CLEANING AND PROTECTION

- A. Clean stainless steel railings by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Protect finishes of railings and handrails from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 53 13 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal bar gratings and metal frames and supports for gratings.
- B. Related Requirements:
 - 1. Section 05 51 19 "Metal Grating Stairs"

1.3 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings.
 - 2. Paint products.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables.

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Alabama Metal Industries Company; a Gibraltar Industries company.
2. All American Grating.
3. Harsco Industrial IKG, a division of Harsco Corporation.
4. Ohio Gratings, Inc.
5. Or Approved Equivalent

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 150 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
2. Walkways and Elevated Platforms Used as Exits: Uniform load of 125 lbf/sq. ft.
3. Heavy Equipment Room Floors: 300 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
4. Electrical Room Floors: 250 lbf/sq. ft. or concentrated load of 2500 lbf, whichever produces the greater stress.
5. Limit deflection to L/360 or 1/4 inch, whichever is less.

B. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.3 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."
- B. Pressure-Locked, Rectangular-Bar Aluminum Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
 - 1. Bearing Bar Spacing: 1-3/16 inch o.c.
 - 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 - 3. Bearing Bar Thickness: As required to comply with structural performance requirements.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Plain.
 - 6. Aluminum Finish: Mill Finish.

2.4 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510.
- D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30.
- E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.
- F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M, Type 316L.
- G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.

2.5 ALUMINUM

- A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 - 2. 6061-T1, for grating crossbars.
- C. Aluminum Sheet: ASTM B 209, Alloy 5052-H32.

2.6 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
- C. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for All Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates for attaching in the field.
 - 2. Toeplate Height: 4 inches unless otherwise indicated.
- F. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 - 1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.
 3. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
 4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
 5. Furnish stainless steel flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
- G. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- H. Do not notch bearing bars at supports to maintain elevation.

2.8 GRATING FRAMES AND SUPPORTS

- A. Aluminum or stainless-steel frames and supports in the following locations:

1. Exterior.
2. Interior.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.
- B. The portion of aluminum frames in contact with concrete shall have a bitumastic coating for protection.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Attach toe plates to gratings by welding at locations indicated.
- F. Field Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 53 13

SECTION 05 60 00 –ACCESS HATCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes watertight access hatches for pumping station wetwells and valve vaults.

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Concrete

1.3 DESIGN REQUIREMENTS

- A. Aluminum Hatches in vaults and structures:
 - 1. Opening size: As shown on drawings.
 - 2. Material: Aluminum with maximum design stress of 17,300 psi per the Aluminum Association
 - 3. Live load: 300 lb/sq ft
 - 4. Single leaf with hinges on one side, spring loaded assist, locking upright door (Provide double leaf doors for hinged openings exceeding 48 inches wide.
 - 5. Gasket sealed for containment of odors
 - 6. Safety Grate: Powder coated aluminum safety Grate with separate, lockable access. Shall be included.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, materials, individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 FABRICATION

- A. Frame: Aluminum, channel or angle type as shown on the drawings, 1/4-inch thickness, coal tar coats all surfaces in contact with concrete, 10 mils min.
- B. Doors to be equipped with:
 - 1. Heavy duty, stainless steel pneumatic dampened spring.
 - 2. Cover to be counterbalanced.

3. Aluminum automatic hold open arm with a red vinyl grip release handle.
- C. Door to lock open in the 90-degree position.
- D. Hinges: 316 stainless steel with 316 stainless steel bolts.
- E. Hardware: All Type 316 stainless steel.
- F. Lift Handle: Flush with top of the 1/4-inch diamond plate.
- G. Sealed with gasket for odor control.
- H. Safety Accessories: Covers installed over wetwells or other water holding structures shall be equipped with lockable aluminum I-bar safety grating.
 1. Aluminum I-bar construction
 2. 316 stainless steel hardware
 3. Tamper-proof stainless-steel hinge bolts
 4. Hinged with positive latch to maintain upright position
 5. 300 p.s.f. load rated.
 6. View are for observation and limited maintenance.
 7. Safety Orange powder coated.
 8. Nut rail and stainless-steel spring nuts.
- I. As manufactured by Halliday, Bilco, Thompson Fabricating or equal

2.2 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Stainless-Steel Finish: Bright, cold-rolled, unpolished No. 2B finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing aluminum access hatches.
- B. Repair nicks or other damage to bituminous surface of frame prior to installation.
- C. Install frames plumb and level in opening. Secure rigidly in place.
- D. Lubricate and adjust for proper operation

3.3 ADJUSTING

- A. Adjust access hatches, after installation, for proper operation.

END OF SECTION 05 60 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Plywood backing panels.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. Application: Treat all miscellaneous carpentry unless otherwise indicated.
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Roof framing and blocking.
3. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of the following species:
1. Mixed southern pine or southern pine; SPIB.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
 7. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:
1. Mixed southern pine or southern pine; SPIB.
- C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

- C. Screws for Fastening to Metal Framing: ASTM C 1002 OR ASTM C 954 as required, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. KC Metals Products, Inc.
 - 2. USP Structural Connectors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 316.
 - 1. Use for exterior locations and where indicated.

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring vertically at 24 inches o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. Section Includes:

- 1. Batt insulation.
- 2. Rigid foam board cavity wall insulation.

B. Related Sections include the following:

- 1. Division 5 Section - "Cold-Formed Metal Framing."
- 2. Division 9 Section - "Gypsum Board Assemblies."
- 3. Division 23 Section - "HVAC Insulation."

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each type of insulation required, including installation instructions. Include data substantiating that the materials comply with specified requirements.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- C. Research/Evaluation Reports: For foam-plastic insulation complying with requirements of the International Building Code.

1.4 QUALITY ASSURANCE:

- A. Source Limitations: Obtain each type of building insulation through one source and from a single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 BATT INSULATION:

- A. Acceptable Manufacturers; subject to compliance with specified requirements:
 - 1. CertainTeed Corporation.
 - 2. Guardian Fiberglass Inc.
 - 3. Johns Manville Corporation/Building Insulation Division.
 - 4. Knauf Insulation.
 - 5. Owens-Corning Fiberglas Corporation.
- B. Type: Unfaced, fiberglass blanket insulation meeting ASTM C665, Type I.
 - 1. Surface Burning Characteristics: Meeting Class A flame spread and smoke developed indexes specified when tested according to ASTM E84.
 - a. Flame Spread Index: Not more than 25.
 - b. Smoke Developed Index: Not more than 50.
 - 2. Combustibility: Noncombustible when tested per ASTM E136.
 - 3. Thermal Resistance and Thickness:
 - a. Walls: R-13 (13 deg F \times h \times sq. ft./Btu at 75 deg F) thermal resistance, 3-1/2-inch thickness; unless otherwise indicated.
 - b. Soffits: R-19 (19 deg F \times h \times sq. ft./Btu at 75 deg F) thermal resistance, 6-1/2-inch thickness; unless otherwise indicated.
 - 4. Size: Manufacturer's standard width equal to spacing of framing members.

2.2 RIGID FOAM BOARD CAVITY WALL INSULATION

- A. Acceptable Products; subject to compliance with specified requirements:
 - 1. Diversifoam Products; CertiFoam 25 SE.

2. Dow Chemical Company, Styrofoam Scoreboard or Square Edge.
3. Owens-Corning, Foamular 250.
4. Kingspan Insulation, LLC; GreenGuard Type IV XPS Insulation Board.

B. Type: Extruded, closed cell polystyrene boards meeting ASTM C578, Type IV.

1. Compressive strength: 25 psi minimum, tested in accord with ASTM D1621.
2. Density: 1.6 pcf, minimum, tested in accord with ASTM C303.
3. Thermal Resistance: R-5.0 per inch (5.0 deg F x h x sq. ft./Btu at 75 deg F) when tested in accord with ASTM C518.
4. Surface Burning Characteristics: Meeting flame spread and smoke developed index specified when tested in accord with ASTM E84.
 - a. Flame Spread Index: Not more than 25.
 - b. Smoke Developed Index: Not more than 200.
5. Thickness: As indicated on Drawings.
6. Sizes: Manufacturer's standard.
7. Edges: Square.

2.3 AUXILIARY MATERIALS:

- A. Fasteners and Supports: Type as recommended by insulation manufacturer for installation conditions encountered.
- B. Adhesive for Bonding Foam Board Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates. Adhesives used with plastic foam insulation for installation in masonry cavity wall construction shall be type compatible with specified fluid-applied air barrier membrane.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.
- B. Cut and fit insulation to maintain thermal integrity over areas indicated to be insulated.

3.3 GENERAL INSTALLATION REQUIREMENTS:

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 BATT INSULATION INSTALLATION:

- A. Install specified batt insulation to exterior framed walls and other areas as indicated, with vapor barrier facing to building interior.
 - 1. Install batt insulation in uninterrupted continuous full height lengths.
 - 2. Friction fit batt insulation snug and tight between framing members.
 - 3. Install batt insulation with butted end joints as required and taped using specified foil-faced tape.
 - 4. Seal tears and holes in vapor barrier facing with foil-faced tape.
- B. Insulate small areas between closely spaced framing members. Cut and fit insulation around pipes, conduits and other obstruction.
- C. Where pipes or conduit are located in stud spaces, place insulation between exterior wall and pipe, compressing insulation where necessary.
- D. Do not install insulation compressed in excess of 10-percent.
- E. Provide supplemental support using wire ties fastened 24-inches on center, maximum to prevent sagging of insulation.

3.5 RIGID FOAM BOARD CAVITY WALL INSULATION INSTALLATION:

- A. Install rigid foam insulation to sheathed metal framed wall construction erected to support masonry veneer only after Architect has inspected and approved application of fluid-applied air barrier membrane to substrates.

- B. Install insulation in cavity air space over sheathing sealed with air barrier membrane of metal framed wall construction. Coordinate installation with attachment of anchors and ties.
- C. Secure insulation to air barrier sealed gypsum sheathing attached to metal framed back-up wall construction using compatible adhesive as recommended by manufacturer.
 - 1. Place small dabs of adhesive, spaced approximately 12-inches on center in each direction, horizontal and vertical, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose.
 - 2. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions.
 - 3. Press units firmly against supporting substrates indicated.
 - 4. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and air barrier membrane applied over gypsum sheathing.

3.6 PROTECTION:

- A. Protect installed insulation material from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Remove and dispose of excess materials, litter and debris; leaving work areas in a clean condition.

END OF SECTION 07 21 00

SECTION 07 26 00 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Polyethylene vapor retarders.

- B. Related Requirements:

- 1. Section 03 30 00 "Cast-in-Place Concrete" for under-slab vapor retarders.
 - 2. Section 07 21 00 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6-mil- thick sheet, with maximum permeance rating of 0.1 perm.

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 26 00

SECTION 07 54 23 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Substrate board.
3. Vapor retarder.
4. Roof insulation.
5. Cover board.
6. Walkways.

- B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Engineer, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of compliance with performance requirements.
2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

- C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field Test Reports:
 - 1. Concrete internal relative humidity test reports.
 - 2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- F. Field quality-control reports.
- G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, substrate board, and other components of roofing system.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
 - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746, ASTM D 4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:
 - 1. Zone 1 (Roof Area Field): 48 lbf/sq. ft.
 - 2. Zone 2 (Roof Area Perimeter): 57 lbf/sq. ft.
 - 3. Zone 3 (Roof Area Corners): 57 lbf/sq. ft.
 - a. Location: 3 feet in each direction from each building corner.

- D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

- A. TPO Sheet: ASTM D 6878/D 6878M, internally fabric- or scrim-reinforced, TPO sheet.
 - 1. Manufacturer:
 - a. Firestone Ultraply TPO
 - b. GAF Everguard TPO
 - c. Or approved equal
 - 2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.
 - 3. Thickness: 60 mils, nominal.
 - 4. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.
- C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- D. Bonding Adhesive: Manufacturer's standard.
- E. Slip Sheet: ASTM D 2178/D 2178M, Type IV; glass fiber; asphalt-impregnated felt.
- F. Slip Sheet: Manufacturer's standard, of thickness required for application.
- G. Metal Termination Bars and battens: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured **or** approved by TPO roof membrane manufacturer.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Thickness:
 - a. Base Layer: 1-1/2 inches.
 - b. Upper Layer: greater than 1 inch.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
 - 1. Material: Match roof insulation.
 - 2. Minimum Thickness: 1/4 inch.
 - 3. Slope:
 - a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
4. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F 2170.
5. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
6. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
7. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
8. Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 1. Submit test result within 24 hours after performing tests.
 - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.
- D. Install sound-absorbing insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

- B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

3.5 ADHERED ROOFING INSTALLATION

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric-backed roof membrane. Do not apply to splice area of roof membrane.
- G. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- H. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- I. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- J. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- K. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 54 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured through-wall flashing.
2. Manufactured reglets.
3. Formed roof-drainage sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leak proof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.

7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of roof-penetration flashing.
 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METAL, TRIM UNITS, FLASHING, COPING, GUTTERS AND DOWNSPOUTS, AND TRIM MATERIALS

- A. Fabricate of minimum 24-gage metal, with minimum 50,000 p.s.i. yield, with 3-coat full strength (70-percent) Kynar 500 resin (20-year) finish. Provide one of the following base metals, to be the same base metal used for Division 13 Section "Pre-Engineered Metal Building Systems":
1. ASTM A 792 aluminum-zinc alloy coated steel sheet ("Galvalume"), or
 2. ASTM A 653, G-90 (galvanized) zinc-coated steel sheet.
 3. Typical metal flashing, except where specifically indicated otherwise.
- B. Prefinished Metal Flashing and 2-Inch High Diverter Strips:
1. Install diverter strips 1'-0" above low roof edge(s) of sloped roofs, at all locations over exterior doors and exterior mechanical units, where roof edge gutters do not occur.
- C. Prefinished Coping System: Provide prefinished aluminum coping system, including chairs, "drainable gutters" at joints, clips, trim and all necessary accessories for a complete and properly installed water-tight system.
1. Product/Manufacturer: Manufactured or brake-metal system, equivalent to "AP Standard Coping" system, as manufactured by Architectural Products Co.; Covington, Kentucky; Phone: 1-606-341-1171 or MRS Rapid-Lock Coping as manufacturer by Metal Roofing Systems, Inc., Lowesville, NC.
 - a. Baked enamel finish on minimum 0.063" (1.6 mm) aluminum sheet or extrusion, with depths and widths indicated on the Drawings, including all necessary trim and accessories as recommended by manufacturer and required by project conditions.
 2. At Contractor's option, provide similar profile, but from brake-metal coping system, with continuous clip across top of and length of parapets (full secondary concealed wall cap), with 1-inch high standing seam joints - filled with sealant, double-folded, and corners turned down at 45-degrees.

D. Finishes:

1. Finish for any exposed metal flashings, coping systems, etc., shall be three-coat 70% resin "Kynar 500" coating with a total dry film thickness of at least 0.24-mil (0.8-mil primer, 0.8-mil color coat, and 0.8-mil clear top coat), complying with AAMA 2605.2.
2. Colors: As selected by Architect, from manufacturer's standard non-metallic colors - 12 colors minimum to select from, to include white, and color(s) to match Division 13 Section "Pre-Engineered Metal Building Systems."

2.2 ELASTIC VINYL SHEET FLASHING

- A. Flexible sheet flashings especially formulated from virgin polyvinyl chloride with plasticizers and other modifiers, to remain flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below.
 1. Thickness: 30 mils; Smooth finish at both sides (not grained, textured, etc.).
- B. Product/Manufacturer: "Nervastral 300", or pre-approved equivalent submitted at least 10-days prior to original Bid Date and subsequently approved, including mastic, and where required companion surface conditioner product, and all other materials and components required.
- C. Application: Use where flashing is fully concealed, including in part, over roof curbs, wall flashing, through-wall flashing at exterior masonry walls, below any exterior caps and sills, at perimeter of all openings in exterior walls (i.e.: doors, windows, louvers, etc.), and elsewhere as indicated and/or required by project conditions.
 1. At heads and sills of openings, and similar locations, turn ends up to form a dam, and to direct water / moisture to weeps and out of walls.
- D. Adhesive for Flashings: Type recommended by manufacturer of flashing material, for each use indicated; All joints shall be sealed.

2.3 SPECIAL FLASHING

- A. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils (1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.
- B. Products - Metal Siding Over Solid Substrates: Provide equivalent to "Ice and Water Shield" waterproofing underlayment, with self-adhesive and self-sealing property, which will not crack, dry out, or rot and is resistant to fungus and bacteria, as manufactured by W.R. Grace & Company - Conn; Atlanta, Georgia, by one of the following:
 1. Atlas Roofing Corporation; StormMaster DG.
 2. Grace, W. R. & Co.; Grace Ice and Water Shield.
 3. Henry Company; Perma-Seal PE.
 4. Johns Manville International, Inc.; Roof Defender.
 5. NEI Advanced Composite Technology; AC Poly Ice and StormSeal.

6. Owens Corning; WeatherLock.
 7. Polyguard Products, Inc.; Polyguard Deck Guard.
 8. Protecto Wrap Company; Rainproof TM.
 9. TAMKO; TW Metal and Tile.
- C. Metal Roofs Over Solid Substrates: Equivalent to “Ultra” high temperature resistant waterproofing roofing underlayment, as manufactured by W.R. Grace & Company - Conn; Atlanta, Georgia.
1. Self-Adhering, High-Temperature Sheet: 30 to 40 mils (0.76 to 1.0 mm) thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 2. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
 3. Low Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
 4. Products:
 - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start “HR” High Performance Roofing Underlayment.
 - b. Grace, W. R. & Co.; Ultra.
 - c. Henry Company; Perma-Seal PE.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. TC MiraDRI; WIP 300HT.
- D. Install 1-layer over entire surface at the following locations:
1. 36-inches wide in all valleys, over all hips and ridges (18-inches on each side of each valley, hip ridge, and top ridge), and at perimeter edges of roof planes; and below all metal roofing, and behind any metal wall panels and metal siding which occurs over solid substrates.
 2. Where roofing planes intersect vertical walls and planes, turn edges up at least 8-inches.
- E. Coordinate with, and refer to any Division 7 Roofing and Siding Sections, and to Section 133122 “Pre-Engineered Metal Building Systems”, for additional information and requirements.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Solder:
1. For use with steel or copper: Provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.
 2. For use with stainless steel: Provide 60 - 40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.
- B. Fasteners: Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
- C. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

- D. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, non-drying, nonmigrating sealant.
- E. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 079200 - "Joint Sealers."
- F. Paper Slip Sheet: 5-lb. rosin-sized building paper.
- G. Counterflashing and Reglets: Metal units of type and profile indicated, or if not indicated, as required for the intended use, compatible with flashing indicated, noncorrosive.
 - 1. At surface-mounted parapet and wall flashing conditions, equivalent to 2-piece "Springlok" Flashing Systems, as manufactured by Fry Reglet; Norcross, Georgia; Phone: 1-770-441-2337, except where brake-formed metal is specifically indicated.
- H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.
- I. Fibered Aluminum Roof Coating: ASTM D 2824, Type II; FS TT-C-1079. Equivalent to Perma-Seal coating No. 3910; Brush applied only.

2.5 FABRICATED UNITS

- A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. Seams: Fabricate nonmoving seams in sheet metal with standing seam at exposed tops and lapped side or edge seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer. Pop-rivet joints for additional strength where required and at vertical faces.
- C. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. General: Except as otherwise indicated, comply with manufacturer's current written installation instructions and recommendations, with SMACNA "Architectural Sheet Metal Manual," and reviewed submittals and shop drawings.
 - 1. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.
- B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of red rosin paper and a course of polyethylene underlayment.
- C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
- D. Install reglets to receive counterflashing in manner and by methods indicated, in a straight line and single elevation.
- E. Install counterflashing in reglets, by snap-in seal arrangement for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure, or if not indicated, as recommended by referenced standards, flashing and roofing manufacturers, and otherwise as required for the intended application.
- F. Nail or anchor flanges of expansion joint units to curb nailers, at maximum spacing of 6 inches o.c. Fabricate seams at joints between units with minimum 3-inch overlap, to form a continuous, waterproof system.
- G. Flashing:
 - 1. Comply with manufacturer's current written instructions and recommendations for installation of all systems components in all applications indicated on the Drawings, and as otherwise required by project conditions.
 - 2. At any parapet wall and roof curbs applications, extend flashing continuous, over top of wall or curb, and turn down one inch (1") minimum on exterior side of wall and mechanically anchor in place at side of top of wall, below and concealed by continuous metal clip anchor (acting as termination bar) and metal cap flashing or coping, and down over top edge of roofing flashing material at roof side.

3.2 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
 - 1. After cleaning, repair and restore damaged metal and metal finishes with prefinished paint manufacturer's special air-drying touch-up paint, in manner such that touch-up is not apparent.

2. Replace damaged flashing and sheet metal work which cannot be repaired and when finish repair and restoration is not acceptable to ARCHITECT/ENGINEER.
- B. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION 07 62 00

SECTION 07 84 00 - FIRESTOPPING

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. Section Includes:

- 1. Through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- 2. Fire-resistive joint systems.

1.3 PERFORMANCE REQUIREMENTS

- A. General Requirements:

- 1. For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- 2. Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

- B. Through-Penetration Firestop System Ratings: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

- 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
 - a. Penetrations located outside wall cavities.
 - b. Penetrations located outside fire-resistance-rated shaft enclosures.

- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For floor penetrations with annular spaces exceeding 4-inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
 - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, with movement capabilities and L-ratings as determined by UL 2079 and complying with requirements of governing building code referenced.

1.4 SUBMITTALS

- A. Product Data: Submit for each type of product indicated.
- B. Shop Drawings: Submit drawing details for each through-penetration firestop system and fire-resistive joint system.
 - 1. Show each type of construction condition penetrated and which joints are installed, relationships to adjoining construction, and type of penetrating item.
 - 2. Include through-penetration firestop and fire-resistive joint system design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
 - 3. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system and fire-resistive joint system configuration for construction and penetrating items.
 - 4. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop or fire-resistive joint condition, submit illustration, with modifications marked, approved by through-penetration firestop system or fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System and Fire-Resistive Joint System Schedule: Indicate locations of each through-penetration firestop system and fire-resistive joint system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of joints to be installed to fire-rated construction.
 - 3. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 4. Types of constructions where joints to be protected occur.
 - 5. Through-penetration firestop systems and fire-resistive joint system for each location identified by assembly design designation of qualified testing and inspecting agency.

- D. Qualification Data: For installer to demonstrate their capabilities and experience; include documentation indicating compliance with specified qualification requirements. Submit for Architect's information only.
- E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system and fire-resistive joint system complies with requirements, based on comprehensive testing of current products. Submit for Architect's information only.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems and fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.
 - 1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.
 - 2. Manufacturer's willingness to sell its through-penetration firestop system and fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Regulatory Requirements: Comply with requirements of the International Building Code, 2012 edition for firestopping penetrations and for fire-resistant joint protection.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems and fire-resistive joint systems that comply with the following requirements and those specified in this section:
 - 1. Firestopping systems and fire resistive joint systems tests are performed by a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems and fire-resistive joint systems are identical to those tested per referenced testing standard. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system and fire-resistive joint system products shall bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems and fire-resistive joint systems shall correspond to those indicated by reference to through-penetration firestop system and fire-resistive joint system designations listed of the qualified testing and inspecting agency.
 - c. Classification markings on penetration firestopping systems and fire-resistive joint systems shall correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group, plc in its "Building Products Directory."
 - 3) FM Global in its "Building Materials Approval Guide."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system and fire-resistive joint systems products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems and fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems and fire-resistive joint systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings, joints and penetrating items to ensure that through-penetration firestop systems and fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Do not cover up through-penetration firestop system and fire-resistive joint systems installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with requirements:
 - 1. A/D Fire Protection Systems Inc.
 - 2. W. R. Grace & Co. - Conn.
 - 3. Hilti, Inc.
 - 4. Johns Manville.
 - 5. Nelson Firestop Products.
 - 6. RectorSeal Corporation.

7. Specified Technologies Inc.
8. 3M; Fire Protection Products Division.
9. Tremco, Inc.; Sealant/Weatherproofing Division.
10. USG Corporation.

2.2 THROUGH-PENETRATION FIRESTOP SYSTEMS

- A. Through-Penetration Firestop Systems: Field-constructed firestopping for penetrations through fire-rated walls and floors composed of materials and accessories assembled in accord with Through-Penetration Firestopping System designs meeting specified performance requirements.
- B. Firestop Devices: Factory-assembled, self-contained firestopping devices for penetrations through fire-rated walls and floors meeting specified through-penetration firestop system performance requirements.
 1. Cast-in-Place Devices: Designed for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 2. Collar Devices: Collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Compatibility: Provide through-penetration firestop systems and devices that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- D. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include the following items:
 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.3 FIRE-RESISTIVE JOINT SYSTEMS

- A. Fire-Resistive Joint Systems: Fire-resistant joint construction designed to prevent the spread of fire through wall and floor assemblies, including floor to wall joints at perimeter spandrel conditions, composed of materials and accessories assembled in accord with joint system designs meeting specified performance requirements.
 - 1. Fire-resistive joint systems used in construction other than masonry, precast or concrete wall construction may be of any product of the manufacturers specified complying with specification requirements.
 - 2. Fire-resistive joints systems used in masonry, precast concrete and cast-in-place concrete wall construction shall be limited only to systems using sealant products specified in the article of this specification section indicated for such use.
- B. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.
- C. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with specified performance requirements. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

2.4 FILL MATERIALS

- A. General: Provide through-penetration firestop systems and fire-resistive joint systems containing the types of fill materials indicated in the Through-Penetration Firestop System and Fire-Resistive Joint System designs. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
 - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.5 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system and fire-resistive joint systems manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, joint configurations, penetrating items, substrates, and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately before installing through-penetration firestop systems or fire-resistive joint systems to comply with system manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening and joint substrates including penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping and joint system materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.

- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system and fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems or fire-resistive joint systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestopping or joint system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with specified performance requirements and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIRE-RESISTIVE JOINT SYSTEM INSTALLATION

- A. General: Install fire-resistive joint systems to comply with specified performance requirements and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.
- B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply fill materials so they contact and adhere to substrates formed by joints.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6-inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems.
 1. Use mechanical fasteners for metal labels.
 2. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted.
 3. Include the following information on labels:
 - a. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Contractor's name, address, and phone number.
 - c. Through-penetration firestop system designation of applicable testing and inspecting agency.
 - d. Date of installation.
 - e. Through-penetration firestop system manufacturer's name.
 - f. Installer's name.
- B. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6-inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system.
 1. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.
 2. Include the following information on labels:
 - a. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Contractor's name, address, and phone number.
 - c. Designation of applicable testing agency.
 - d. Date of installation.
 - e. Manufacturer's name.
 - f. Installer's name.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems and fire-resistive joint systems are without damage or

deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping and joint systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work described in this section includes joint sealer systems.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 03 30 00 – Cast-in-Place Concrete
 - 2. Section 09 96 00 – High-Performance Coatings

1.3 SYSTEM PERFORMANCES

- A. Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications, handling, installation, curing instructions, color charts and performance tested data sheets for each product required.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer who has successfully completed within the last three years at least three (3) joint sealer applications similar in type and size to that of this project and who will assign mechanics from these earlier applications to this project, of which one will serve as lead mechanic.
- B. Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.

1.6 DELIVER, STORAGE AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40°F.
 2. When joint substrates are wet due to rain, frost, condensation or other causes.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.
- B. Colors: Provide color of exposed joint sealers indicated or, if not otherwise indicated, as selected by from manufacturer's standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
- B. Multi-Part Nonsag Urethane Sealant: Type M, Grade NS, Class 25, Uses NR, M, A and, as applicable to joint substrates indicated, O.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dynatrol 11" Pecora Corp.
 - b. "Sonolastic NP-2"; Sonneborn.
 - c. "Dymeric 511"; Tremco Inc.
 - d. "Vulkem 922"; Mameco International, Inc.
 2. Locations for Use: Exterior joints and penetrations in vertical surfaces of stucco, concrete, and between metal and concrete, mortar of stone; overhead or ceiling joints; perimeters of metal frames in exterior walls; vertical expansion and control joints in masonry and concrete; and at all miscellaneous locations requiring a joint sealant.
 3. Equivalent 1-part sealants will be acceptable, by one of the above-named manufacturers.
- C. Two-Part Pourable Urethane Sealant: Type M, Grade P, Class 25; Uses T, M, A and, as applicable to joint substrates indicated, O.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 550"; Bostik Construction Product Div.
 - b. "Vulkem 245"; Mameco International, Inc.
 - c. "Pourthane"; W. R. Meadows, Inc.
 - d. "NR-200 Urexpan"; Pecora Corp.
 - e. "Sonolastic Paving Joint Sealant"; Sonneborn Building Products Div.,
 - f. "Rexnord Chem. Prod. Inc.
 - g. "THC-900/901"; Tremco Corp.

2. Locations for Use: Exterior and interior expansion, control and construction joints in horizontal surfaces; and joints subject to pedestrian and light vehicular traffic.
 3. Equivalent 1-part sealants will be acceptable, by one of the above named manufacturers.
- D. One-Part Mildew-Resistant Silicone Sealant: Type S, Grade NS; Class 25, Uses NT, G, A and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide for sealing interior joints with nonporous substrates around ceramic tile, showers, sinks and plumbing fixtures.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dow-Corning 786"; Dow Corning Corp.
 - b. "SCS 1702"; General Electric.
 - c. "863 #345 White"; Pecora Corp.
 - d. "Proglaze White"; Tremco Corp.
 2. Locations for Use: Interior joints in vertical surfaces and terminal edges of tile; and joints at damp areas, such as around sinks and plumbing fixtures and pipe penetrations; and exposed terminal edges of vinyl flooring, such as around door frames and terminations at concrete.

2.3 LATEX JOINT SEALERS

- A. Acrylic-Emulsion Sealant: Manufacturer's standard, one-part nonsag, acrylic, mildew resistant, acrylic emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior and on protected exterior exposures involving joint movement of not more than $\pm 7.5\%$.
1. Products: Subject to compliance with requirements, provide with one of the following:
 - a. "Chem-Calk 600"; Bostik Construction Products Div.
 - b. "AC-20"; Pecora Corp.
 - c. "Sonolac"; Sonneborn Building Products Div; Rexnord Chemical Prod., Inc.
 - d. "Tremco Acrylic Latex Caulk"; Tremco Inc.
 2. Locations for Use: Interior joints in field-painted vertical and overhead surfaces at perimeter of metal door frames, gypsum drywall, plaster and concrete or concrete masonry; and all other interior locations not indicated otherwise.

2.4 SILICONE WEATHERSEAL SEALANT

- A. Acceptable Products; subject to compliance with specified requirements:
1. Dow Corning Corp.; 790 Silicone Building Sealant.
 2. Pecora Corp.; 890NST.
 3. Tremco, Inc.; Spectrum I.
- B. Characteristics:
1. Type: One part low modulus silicone rubber; meeting ASTM C 920, Type S, Grade NS, Class 100/50.
 2. Joint Movement Capability: Plus 100% extension, minus 50% compression, minimum.

3. Colors: As selected by Architect from manufacturer's standard full range color selection.

2.5 ONE-PART POLYURETHANE SEALANT

A. Acceptable Products; subject to compliance with specified requirements:

1. BASF Corporation; MasterSeal NP 1.
2. Pecora Corp., Dynatrol™ I-XL
3. Sika Corporation; Sikaflex-1a
4. Tremco, Inc., Dymonic 100.

B. Characteristics:

1. Type: One-part, non-sag, elastomeric polyurethane sealant meeting ASTM C920, Type S, Grade NS, Class 25; compatible for painting.
2. Color: As selected by the Architect from Manufacturer's standard selection for compatibility with paint colors used.

2.6 POLYURETHANE SEALANT FOR HORIZONTAL TRAFFIC-BEARING JOINTS

A. Acceptable Products; subject to compliance with specified requirements:

1. BASF Corporation; MasterSeal SL 1 or SL 2
2. Pecora Corporation; Urexpan NR-200 or DynaTrol II-SG.
3. Sika Corporation; Sikaflex-2c SL.
4. Sonneborn / BASF Construction Chemicals, LLC; Sonolastic SL-1 or SL-2.
5. Tremco, Inc.; Vulkem 45SSL or THC-901.

B. Characteristics:

1. Type: Single or multi-component, polyurethane sealant formulated for horizontal traffic bearing surfaces, meeting ASTM C920, Type S or M, Grade P or NS, Class 25; self-leveling for flat surfaces and non-sag for sloped surfaces.
2. Color: As selected by the Architect from Manufacturer's standard selection.

2.7 SILICONE BATH SEALANT

A. Acceptable Products; subject to compliance with specified requirements:

1. BASF Corporation; MasterSeal 121.
2. Dow Corning Corp.; 786 Mildew-Resistant Silicone Sealant.
3. Momentive Performance Materials, Inc. (GE); SCS 1700 Sanitary Silicone Sealant.
4. Pecora Corporation; 898NST Sanitary Mildew Resistant Silicone Sealant.

B. Characteristics:

1. Type: One part silicone rubber; mildew and stain resistant meeting ASTM C 920, Type S, Grade NS; USDA or FDA approved.
2. Color: White.

2.8 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint-Fillers:
 1. Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam of material indicated below, and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 2. Backer Rod: Premium grade, closed cell polyethylene foam rod; Sealtight Backer Rod, as manufactured by W.R. Meadows, Inc., or approved equal.
 3. Joint Filler: "Cerammar" flexible foam expansion joint filler, as manufactured by W.R. Meadows, Inc., or approved equal.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (3rd) surface of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Provide non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
- C. Masking Tape: Provide non-staining, non-absorbent type compatible with joint sealants and to surface adjacent to joints.
- D. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam or neoprene foam as recommended by material manufacturer for compatibility with sealant. Provide size and shape of rod to control joint depth, break bond at bottom of joint, form optimum shape of bead on back side and minimize possibility of extrusion when joint is compressed.
- E. Tooling Agent: Agent recommended by the material manufacturer to insure contact of material with inner joint faces.
- F. Divider Strips: Synthetic rubber or closed cell synthetic foam not less than 1/16-inch thickness and full depth of sealant or caulking compound; approved by manufacturers of dissimilar materials as being compatible with each other.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Require Installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Obtain Installer's written report listing any conditions detrimental to performance of joint sealer work. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:
 - 1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; oil; grease; waterproofing; water repellents; water; surface dirt and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 - 3. Remove laitance and form release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile and other non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.
- D. Installation of Sealant Backings:
 - 1. Install sealant backings to comply with the following requirements:
 - 2. Install joint-fillers of type indicated or recommended by sealant manufacturer to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.

- a. Do not leave gaps between ends of joint-fillers.
 - b. Do not stretch, twist, puncture or tear joint-fillers.
 - c. Remove absorbent joint-fillers which have become wet prior to sealant application and replace with dry material.
3. Install bond breaker tape between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.
- E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants:
 1. Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 2. Concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.
 1. Sound sealant shall not be visible on exposed surfaces.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Hollow metal doors and frames, including borrowed lite frames.
- B. Related work specified elsewhere includes:
 - 1. Division 6 Section – "Rough Carpentry"
 - 2. Division 8 Section – "Flush Wood Doors."
 - 3. Division 8 Section – "Door Hardware"
 - 4. Division 8 Section – "Glazing."
 - 5. Division 9 Section – "Gypsum Board Assemblies"
 - 6. Division 9 Section – "Painting"

1.3 PERFORMANCE REQUIREMENTS

- A. Quality Standards: Provide doors and frames complying with Steel Door Institute ANSI/SDI-A250.8 "Recommended Specifications for Standard Steel Doors and Frames (SDI-100)" and as herein specified.
- B. Physical Endurance: Comply with performance requirements for specified level and model classification in accordance with ANSI/SDI-A250.8-2014 (SDI-100) and ANSI/SDI-A250.4-2011 for frames, frame anchors and hardware reinforcing.
- C. Finish Performance: Comply with the standard performance criteria of ANSI A250.10-2011 for primed steel surfaces.
- D. Thermal Performance: $U=0.07$ ($R=14$) or better for exterior doors, complying with SDI 113-13.
- E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 based on testing at positive pressure according to NFPA 252 or UL 10C for fire-protection ratings indicated.
 - 1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 - 2. Smoke and Draft Control: Fire rated door assemblies shall be listed and labeled for smoke and draft control by Underwriters Laboratories (UL), Intertek Warnock Hersey

(WHI), or another qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

3. Fire Labels: Fire-rated assemblies shall be labeled and listed by Underwriters Laboratories (UL), Intertek Warnock Hersey (WHI), or another testing and inspecting agency acceptable to authorities having jurisdiction.

- F. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data substantiating that products comply with requirements.
- B. Shop Drawings: Submit for fabrication and installation of steel doors and frames.
 1. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.
 2. Include details of conduit and preparations for power, signal, and control systems.
 3. Show anchorage and accessory items.
 4. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
- C. Door and Frame Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from a single source and from a single manufacturer.
- B. Pre-Installation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equivalent in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

- D. Store frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch spacers between each stacked door to permit air circulation. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with specified requirements:

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Habersham Metal Products Company
4. Mesker Door Inc.
5. Pioneer Industries, Inc..
6. Republic Doors and Frames.
7. Steelcraft / Allegion, plc .

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Galvanized or Galvannealed Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 zinc-coated (galvanized) or A60 zinc-iron alloy-coated (galvannealed) with smooth and paintable finish.
- D. Frame Anchors:
1. Anchors for Interior Frames: ASTM A 879/A 879M, Commercial Steel (CS), Coating Designation 04Z; mill phosphatized.
 2. Anchors for Exterior Frames: Steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

- G. Galvanizing Repair Paint: High zinc dust content paint for repair of galvanized surfaces damaged by fabrication or welding, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- H. Shop Applied Primer: Rust-inhibitive enamel or paint, either air drying or baking, suitable as a base for specified finish paints.
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 HOLLOW METAL DOORS

- A. Door Designs: As indicated on Drawings.
- B. Door Thickness: 1-3/4 inch unless otherwise indicated.
- C. SDI Door Classification: Level III (Extra Heavy Duty), Model 2 (Seamless) per ANSI/SDI A250.8 for all interior and exterior doors, including fire-rated doors.
- D. Door Construction:
 - 1. Door Faces: Complying with requirements of specified door classification.
 - a. Interior Doors: Fabricated from specified cold-rolled steel sheets; minimum 16-gauge (0.053-inch) thickness.
 - b. Exterior Doors: Fabricated from specified hot dip galvanized or galvanized steel sheets; minimum 16-gauge (0.053-inch) thickness.
 - 2. Internal Core:
 - a. Interior Doors: Manufacturer's standard kraft-paper honeycomb or vertical steel-stiffener core.
 - b. Exterior Doors: Manufacturer's polyurethane core meeting specified thermal performance requirements.
 - c. Fire Doors: Core material and construction as required to provide fire protection and temperature-rise ratings indicated and complying with specified fire testing requirements.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge to 1/8-inch in 2 inches.
 - 4. Top and Bottom Edge Closures: Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 16-gauge (0.053-inch) thickness steel channels, with channel webs placed even with top and bottom edges; flush welded.
 - 5. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
 - 6. Weeps: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

- E. Fire Rated Doors: Provide labeled doors with fire-tested core construction for required ratings complying with specified SDI door classification requirements. Fabricate doors with face sheets same as specified for interior and exterior doors as applicable for locations indicated.
- F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

2.4 HOLLOW METAL FRAMES

- A. Frame Profiles: All frames shall be of double rabbeted profile; except where single-rabbeted frames are specifically indicated on the Drawings.
- B. SDI Frame Classification: Level III (Extra Heavy Duty) per ANSI/SDI A250.8.
- C. Frame Construction: Welded frames fabricated from steel sheet materials as specified. Knock-down frames shall not be permitted.
 - 1. Interior Frames: Fabricated from specified cold-rolled steel sheets; minimum 16-gauge (0.053-inch) thickness.
 - 2. Exterior Frames: Fabricated from specified hot dip galvanized or galvanized steel sheets; minimum 16-gauge (0.053-inch) thickness.
 - 3. Frames for Borrowed Lights: Fabricated same as adjacent door frame but not less than 16-gauge (0.053-inch) thickness steel sheet material.
 - 4. Frame Corners: Mitered or coped and full profile welded. Welds shall be dressed and ground smooth with no visible seams.
- D. Fire-Rated Frames: Fabricated from same material, construction and SDI Classification Level as specified for interior and exterior frames as applicable for locations indicated and bearing fire labels of specified testing and inspection agency.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames. Reinforcement shall be provided for strikes, closers and brackets, and other surface applied hardware for field drilling and tapping.
- F. Temporary Spreaders: Provide frames with removable temporary spreader bars welded to bottom of each jamb and maintain in place during shipping, storage and handling.
- G. Plaster Guards: Provide 26-gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation.
- H. Frame Anchors: Fabricated from not less than 18-gauge (0.042-inch) specified steel sheet for interior frames.
 - 1. Floor anchors: Clip type with 5/16-inch holes provided to receive two fasteners per jamb; welded to inside of each jamb at frame bottom for securing to floor substrate.
 - 2. Jamb Anchors: Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

- a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 18-gauge (0.042 inch) thickness, with corrugated or perforated straps not less than 2-inches wide by 10-inches length; or wire anchors not less than 3/16-inch (0.187-inch) diameter.
- b. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 18-gauge (0.042-inch) thickness.
- c. Post-Installed Expansion Type for Frame Installation to In-Place Masonry: Post-installed expansion anchor assembly consisting of minimum 3/8-inch diameter countersunk, flat head, stove bolts with expansion shields, spaced 6-inch maximum from top and bottom of frame and 24-inches (2-ft) on center, maximum in between. Provide with 16-gauge steel shield and sleeve spacers at each bolt, fitted inside frames.
- d. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames having no floor anchors. Provide one additional anchor for each 24-inches of frame height above 7-feet.

- I. Setting Bars: Furnish welded frames with setting bars for installation use.

2.5 LOUVERS, STOPS MOLDINGS AND ACCESSORIES

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8-inch high unless otherwise indicated.
- B. Louvers: Sightproof design, inverted 'V' or 'Y' type, with minimum 20-gauge (0.032-inch) blades welded in 18-gauge (0.042-inch) thickness frame; providing minimum 50-percent free air movement.
- C. Exposed Fasteners: Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FABRICATION

- A. Fabricate hollow metal door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at project site.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel.
- C. Fabricate exterior doors, panels and frames from specified galvanized sheet steel.
- D. Fabricate frames in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 1. Frames shall be formed by press brake with corners sharp and true.

2. Corners shall be mitered and accurately fitted, and shall be fully electrically welded and then ground smooth.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Finish Hardware Preparation:
1. Prepare doors and frames to receive mortise and concealed finish hardware according to final reviewed Finish Hardware Schedule and templates provided by hardware supplier.
 2. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 3. Reinforce doors and frames to receive surface applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
 4. Doors and frames shall be accurately mortised for hardware.
 5. Locate finish hardware as indicated on final shop drawings, or if not indicated, in accordance with "Recommended Locations for Builders' Hardware," published by Door and Hardware Institute.
 6. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches on center. and not more than 2 inches on center from each corner.
- H. Use galvanizing repair paint to coat surfaces damaged by fabrication or welding.
- I. Shop Painting:
1. Clean, treat and paint exposed surfaces of metal door and frame units, including galvanized surfaces.
 2. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.
 3. Use galvanizing repair paint for galvanized surfaces damaged by fabrication or welding, prior to prime coat.
 4. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

- J. Fabrication Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hollow metal doors frames and accessories according to final reviewed shop drawings and manufacturer's written instructions, and as herein specified.
- B. Placing Frames:
1. Comply with provisions of ANSI/SDI A250.11 "Recommended Erection Instructions for Steel Frames," unless otherwise indicated.
 2. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. Remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 3. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 4. Pack mineral-fiber insulation solid behind frames in metal-stud partitions.
 5. In masonry construction, locate a minimum of 3 wall anchors per jamb at hinge and strike levels. Add one (1) wall anchor per jamb at hinge and strike levels for each whole 1'-10" height increment over 6'-0"; similar at glazed and cased openings.
 6. At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.
 7. Field apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
 8. Install fire-rated frames according to NFPA 80.
- C. Door Installation:
1. Fit doors accurately in hollow metal frames, within clearances specified in SDI-100.
 2. Install fire-rated doors with clearances as specified in NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
 4. Install silencers after all painting of frames has been completed.

3.2 INSTALLATION TOLERANCES

- A. Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
1. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
 3. Twist: Plus or minus 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus or minus 1/16-inch, measured at jambs at floor.

3.3 ADJUST AND CLEAN

A. Prime Coat Touch-up:

1. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
2. Use galvanizing repair paint for galvanized surfaces, prior to prime coat.

- #### B. Final Adjustments:
- Check and readjust operating finish hardware items, leaving hollow metal frames undamaged and in sound condition for hanging doors.

END OF SECTION 08 11 13

SECTION 08 16 13 – FIBERGLASS REINFORCED PLASTIC (FRP) DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fiberglass Reinforced Plastic (FRP) doors and frames
2. Louvers
3. Anchors for FRP frames hollow-metal work.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for door hardware for FRP doors.

1.2 COORDINATION

- A. Coordinate anchorage installation for FRP frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and door plate thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Gel coat description and thicknesses

- C. Schedule: Provide a schedule of door and frame work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of FRP door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver FRP doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver frames with two removable spreader bars across bottom of frames.
- C. Store vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chem-Pruf Door Company, Brownsville, Texas.
 - 2. Warminster Fiberglass.
 - 3. Composite Structures, Inc. (Tiger Door)- Omaha, NB.
 - 4. Approved Equal
- B. Source Limitations: Obtain FRP doors and frames from single source from single manufacturer.

2.2 DOORS

- A. Door shall be made of fiberglass reinforced plastic (FRP) using resins tailored to a corrosive environment, ultraviolet resistant and have a fiberglass content of 25% by weight over an end grain balsa wood, expanded polyurethane or phenolic coated kraft honeycomb core.
- B. The doors shall be flush construction, having no seams or cracks. All mortises shall be prepared at the factory.
- C. The doors shall be 1-3/4" thick with a 15 mil (plus or minus 3 mils) color gelcoat and have an R-factor of 12. Secondary painting over pultrusions to achieve color is not acceptable.

2.3 STILES AND RAILS

- A. Shall be constructed starting from the outside toward the inside, of a 15-20 mil gel coat of the color specified followed by a matrix of at least two layers of 1.5 ounce per square foot of fiberglass mat, plus one layer of fiberglass cloth.
- B. The stile and rail shall be the exact dimensions of the door. Pultrusions will be acceptable for stiles and rails.

2.4 DOOR PLATES

- A. Door plates shall be molded in one continuous piece, starting with a 15-20 mil gel coat of the color specified, integrally molded with at least two layers of 1.5 ounce per square foot fiberglass mat and layer of 16 ounce per square yard unidirectional glass roving.

2.5 REINFORCEMENT

- A. Adequate reinforcing and compression members shall be used to accommodate surface hinges, closers, locksets, kickplates, push or pull plates.
- B. When engineering considerations dictate, mild steel is buried in the fiberglass matrix to provide enhanced screw holding power.
- C. When thru-bolting is to occur, a compression member is to be located which will provide memory and resistance to the torquing of thru-bolts.

2.6 2.5 COATING

- A. The color of the door or frame shall be integrally molded as the part is made.

2.7 2.6 FRAMES

- A. Frames shall be similar to the doors in construction and materials except the frames shall be solid fiberglass.
- B. The stop and frame will be molded all in one piece.
- C. The frame shall be integrally gel-coated to the customer's color when molded or pultruded and finished with a polyurethane coating.
- D. Mortises shall be factory prepared.
- E. Reinforcement for mounting hinges, closers, etc., shall be either of mild steel plates or fiberglass. Steel plates shall be encapsulated in the resin-glass matrix.

- F. The jamb shall conform dimensionally to standard hollow metal jambs but may be flat on the backside.

2.8 LOUVERS

- A. Louvers shall be identical to the doors in construction and materials or 304 stainless steel.
- B. The fins shall be solid fiberglass or 304 stainless steel.

2.9 TRANSOMS:

- A. All transoms shall be identical to the doors in construction, materials, thickness, and reinforcement.

2.10 2.9 HARDWARE:

- A. All hardware (locksets, hinges, closers, etc.) shall be installed at the door manufacturing plant.
- B. The hardware manufacturer's warranty shall be included with the hardware installation.
- C. Hardware is specified elsewhere in Division 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove shipping spreaders installed at factory.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install FRP doors, frames and accessories work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. FRP Frames: Install FRP frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install frames with removable stops located on secure side of opening.
 - b. Install door silencers in frames before grouting.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. FRP Doors: Fit FRP doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - 2. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.

3. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
4. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

D. Glazing:

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from FRP work immediately after installation.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

END OF SECTION 08 16 13

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes access doors for installation in the following types of construction:
 - 1. Gypsum drywall.
 - 2. Unit masonry.
 - 3. Other construction as otherwise indicated.
- B. Provide fire-rated access doors where indicated or scheduled, and at access openings at walls and ceilings indicated or required by building code to be fire-rated.
- C. Related Sections:
 - 1. Division 3 Section - "Concrete"
 - 2. Division 4 Section - "Unit Masonry"
 - 3. Division 5 Section - "Cold-Formed Metal Framing."
 - 4. Division 6 Section - "Rough Carpentry"
 - 5. Division 7 Section - "Joint Sealants"
 - 6. Division 9 Section - "Gypsum Board Assemblies"
 - 7. Division 9 Section - "Painting"
 - 8. Divisions 22, 23 and 26 Sections (additional access doors provided and installed by Contractors for Plumbing, Mechanical, Electrical, and related work).

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of access door assembly.
 - 1. Include setting drawings, templates, instructions, and directions for installation of anchorage devices.
 - 2. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, finishes, latching or locking provisions, and other data pertinent to installation.
- B. Shop Drawings: Submit drawings showing fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage and accessory items.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire project from a single manufacturer and from one source.
- B. Fire-Rated Access Doors and Frames: Provide assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated and tested according to NFPA 252 or UL 10B.
 - 1. Fire-Rated assemblies shall be labeled and listed by Underwriters Laboratories, Inc. (UL), Intertek Warnock Hersey (WH-ETL), or another testing and inspecting agency acceptable to authorities having jurisdiction and bear identification markings indicating ratings.
 - 2. Assembly rating shall equal or exceed fire rating of construction in which it is installed.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- D. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.5 PROJECT CONDITIONS

- A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.
- B. Special-Size Access Doors: Use where required or requested; indicate on schedule.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

- A. Acceptable Manufacturers; subject to compliance with requirements, provide access doors by one of the following:
 - 1. Cesco Products / Div. Mestik, Inc.
 - 2. J.L. Industries, Inc.
 - 3. Karp Associates, Inc.
 - 4. Larsens Manufacturing Co.
 - 5. Milcor / Hart & Cooley, Inc.
 - 6. Nystrom, Inc.
 - 7. The Williams Brothers Corp.

2.2 MATERIALS AND FABRICATION

- A. General: Furnish each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.

- B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.
- C. Frames: Fabricate from 16-gage galvanized steel, or 18-gage stainless steel with No. 4 satin finish, to match doors required at various locations.
 - 1. Fabricate frame with exposed flange, nominal 1-inch wide around perimeter of frame for units installed in the following construction:
 - a. Exposed masonry.
 - b. Exposed concrete.
 - 2. For gypsum drywall, furnish perforated flange frames with drywall bead.
- D. Painted Flush Panel Doors (non-fire-rated and fire-rated): Fabricate from not less than 16-gage galvanized sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees.
 - 1. Finish with manufacturer's factory-applied prime paint.
 - 2. Restore any damage to galvanized finish with cold-process galvanizing repair paint, prior to applying factory prime coating, or other finishes.
- E. Stainless Steel Flush Panel Doors: Fabricate from not less than 18-gage stainless steel sheet, with concealed spring hinges or concealed piano hinge set to open 175 degrees. Buff exposed surfaces to #4 satin finish, except where other finishes are indicated.
- F. For fire-rated units, provide manufacturer's standard insulated flush panel/doors, with continuous piano hinge and self-closing mechanism.
- G. Locking Devices: Furnish flush, screwdriver-operated cam locks of number required to hold door in flush, smooth plane when closed.
- H. Finishes:
 - 1. Exterior: Two-coat fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
 - a. Coating System Thickness: Minimum 1.2-mil dry film thickness; consisting of 0.3 (± 0.1) mil primer and minimum 1.0-mil color coat.
 - b. Color: As selected by Architect from manufacturer's full range selection containing not less than fifteen (15) standard colors.
 - 2. Interior, Exposed to Normal View: To match finish of construction to which it is installed.
 - 3. Interior, in Service Areas and Above Ceilings: Factory primed baked enamel.
 - 4. Toilet Rooms, Janitors Rooms, and Break Rooms: Stainless steel, No. 4, satin finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's current written instructions and recommendations for installation of access doors.
- B. Coordinate installation with work of other trades.
- C. Prepare perimeter of rough openings in concrete, CMU, and other similar masonry with mortar/grout full-depth of wall and to size required; use pressure-treated wood as necessary for other concealed blocking, grounds, and supports at any stud wall construction.
- D. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

3.2 ADJUST AND CLEAN

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service doors.
 - 2. Insulated acoustical service doors.
- B. Related Requirements:
 - 1. Section 05 50 00 – Metal Fabrications
 - 2. Section 07 92 00 – Joint Sealants

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
1. Curtain slats.
 2. Bottom bar.
 3. Guides.
 4. Brackets.
 5. Hood.
 6. Locking device(s).
 7. Include similar Samples of accessories involving color selection.
- E. Certifications:
1. Submit manufacturer's Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.
 2. Provide certification from an accredited acoustical testing laboratory of product compliance noting a minimum 34 STC rating. Assembly shall have been tested in accordance with Laboratory Sound Transmission Loss (ASTM E-90) and STC determination (ASTM E-413).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 and UL 10B.
1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

2. Temperature-Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control: In corridors and smoke barriers, provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10-inch wg for both ambient and elevated temperature tests.
- C. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E 90, calculated according to ASTM E 413, and rated for not less than the STC value indicated.
- D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
1. Design Wind Load: Uniform pressure (velocity pressure) per the IBC acting inward and outward.
 2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and meeting the acceptance criteria of DASMA 108.
 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- B. Windborne-Debris Impact Resistance: Provide glazed and impact-protective] overhead coiling doors that pass missile-impact and cyclic-pressure tests according to ASTM E 1996 for Wind Zone 3 or DASMA 115.

2.3 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McKeon Rolling Steel Door Company
 - b. Alpine Overhead Doors
 - c. Overhead Door Corporation
 - d. Cornell Iron Works, Inc.
 - e. Or Approved Equal
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 cycles and for 10 cycles per day. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.
- D. STC Rating: minimum of 34.
- E. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- F. Door Curtain Material: Aluminum: ASTM B 209 sheet or ASTM B 221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
- G. Door Curtain Slats: Curved or Flat profile slats of 1-7/8-inch to 3-1/4-inch center-to-center height.
 1. General: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated
 2. Perforated Slats: Approximately 1/16-inch to 3/32-inch pinholes, 7/8-inch wide by 3/8-inch high slots 25 percent of total door opening.
 - a. Perforated slats are only required if shown on the Drawings.
 3. Fenestrated Slats: Approximately 3- by 5/8-inch or 4- by 5/8-inch openings spaced approximately 1-1/2 inches apart and beginning 12 inches from jamb guides or 17 percent of total door opening.
 - a. Fenestrated slats are only required if shown on the Drawings.
 4. Vision Panels: Approximately 10- by 1-5/8-inch openings spaced approximately 2 inches apart and beginning 12 inches from end guides; in two rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
 - a. Vision panels are only required if shown on the Drawings.

5. Insulated-Slat Interior Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch and minimum aluminum thickness of 0.032 inch.
 6. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
- I. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8-inch-thick; fabricated from hot-dip galvanized steel, stainless steel or aluminum extrusions and finished to match door.
- J. Curtain Jamb Guides: Galvanized steel, Stainless steel or Aluminum with exposed finish matching curtain slats.
1. Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
- K. Hood: Match curtain material and finish.
1. Shape: Round.
 2. Mounting: As shown on Drawings.
 3. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - a. Galvanized Steel: Nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
 - b. Stainless Steel: 0.025-inch thick stainless-steel sheet, Type 304, complying with ASTM A 666.
 - c. Aluminum: 0.040-inch thick aluminum sheet complying with ASTM B 209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.
 4. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.
- L. Locking Devices: Equip door with slide bolt for padlock.
1. Locking Device Assembly: Locking by padlock, located on both left and right jamb sides, operable from coil side.
 2. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
 3. Chain Lock Keeper: Suitable for padlock.
- M. Manual Door Operator: Push-up operation.

1. General: Equip door with manual door operator by door manufacturer.
2. Provide manual chain hoist operators unless electric door operators are indicated.
3. Required lifts or pull for door operation does not exceed 25 lbf.
4. Provide operator with through-wall shaft operation.
5. Provide operator with manufacturer's standard removable operating arm.
6. Provide manual chain-hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 35-lbf force for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

N. Counterbalancing Mechanism

1. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
2. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
3. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
4. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
5. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

O. Curtain Accessories: Equip door with smoke seals, weather seals, and push/pull handles.

1. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
2. Weather seals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - a. At door head, use 1/8-inch thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
 - b. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch thick seals of flexible vinyl, rubber, or neoprene.
3. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

P. Door Finish:

1. General:

- a. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
 - b. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- Q. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, application, and baking.
- 1. Baked-Enamel or Powder-Coated Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
 - 2. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness
 - 3. Stainless-Steel Finish: No. 2B (bright, cold rolled) or No. 4 (polished directional satin).
 - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1) Run grain of directional finishes with long dimension of each piece.
 - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3) Directional Satin Finish: No. 4.
 - c. Bright, Cold-Rolled, Unpolished Finish: No. 2B
 - 4. Interior Curtain-Slat Facing: Finish as indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Fire-Rated Doors: Install according to NFPA 80.
- E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance, including emergency callback service, during normal working hours.
 - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

- 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Folding doors.
- 2. Cylinders for door hardware specified in other Sections.
- 3. Electrified door hardware.

B. Related Requirements:

- 1. Coordinate products specified in Part 2 with Division 08 Sections in subparagraphs below. Astragals, silencers, and cylinders can be specified in this Section or with doors and frames.
- 2. Division 8 – Openings
- 3. Division 13 – Special Construction

1.3 COORDINATION

A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

- 1. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation and Keying Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant.
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For each type of exposed product, in each finish specified.
 - 1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.

2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.

- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.
 - c. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- B. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the ABA standards of the Federal agency having jurisdiction.
1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 1. Door hardware is scheduled in Part 3.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - c. Or approved equal.

2.5 SELF-CLOSING HINGES AND PIVOTS

- A. Self-Closing Hinges and Pivots: BHMA A156.17.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - c. Or approved equal.

2.6 CENTER-HUNG AND OFFSET PIVOTS

- A. Center-Hung and Offset Pivots: BHMA A156.4.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hager Companies.
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - c. Or approved equal.

2.7 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Pin-and-Barrel-Type Hinges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Select Products Limited.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - d. Or approved equal.

2.8 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latch bolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latch bolt throw.
 - 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latch bolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- E. Locks and Latches: BHMA A156.2, BHMA A156.12, BHMA A156.13, BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Stanley Security Solutions, Inc.
 - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - d. Yale Security Inc; an ASSA ABLOY Group company.
 - e. Or approved equal.

2.9 EXIT LOCKS AND EXIT ALARMS

- A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Hardware, Inc.; a Stanley company.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.
 - c. Or approved equal.

2.10 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Trimco.
 - c. Or approved equal.

2.11 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Trimco.
 - c. Or approved equal.

2.12 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Hardware, Inc.; a Stanley company.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.
 - c. Yale Security Inc; an ASSA ABLOY Group company.
 - d. Or approved equal.

2.13 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best Access Systems; Stanley Security Solutions, Inc.
 - b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - c. Hager Companies.
 - d. SARGENT Manufacturing Company; ASSA ABLOY.
 - e. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - f. Yale Security Inc; an ASSA ABLOY Group company.
 - g. Or approved equal.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 2 permanent cores; face finished to match lockset.
 1. Core Type: Interchangeable.
- C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide ten (10) construction master keys.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide ten (10) construction master keys.

2.14 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Supplier is to closely coordinate with owner and architect all keying requirements. All lock cylinders shall be construction master keyed using split key method. Incorporate decisions made in keying conference.
 1. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three (3) cylinder change keys and five (5) master keys.
 2. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 3. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."

2.15 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; aluminum or stainless steel unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Hager Companies.
 - c. Trimco.
 - d. Or approved equal.

2.16 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.17 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SARGENT Manufacturing Company; ASSA ABLOY.
 - b. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 - c. Yale Security Inc; an ASSA ABLOY Group company.
 - d. Or approved equal.

2.18 CONCEALED CLOSERS

- A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. SARGENT Manufacturing Company; ASSA ABLOY.
- b. Or approved equal.

2.19 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

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

- a. Hager Companies.
- b. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
- c. Trimco.
- d. Or approved equal.

2.20 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Allegion plc.
- b. Or approved equal.

2.21 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

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

- a. Hager Companies.
- b. Reese Enterprises, Inc.
- c. Zero International, Inc.
- d. Or approved equal.

- B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.22 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. National Guard Products, Inc.
 - c. Reese Enterprises, Inc.
 - d. Zero International, Inc.
 - e. Or approved equal.

2.23 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Allegion plc.
 - b. Or approved equal.

2.24 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.25 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than .
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DOOR HARDWARE SCHEDULE

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

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. Section Includes:

- 1. Glazing for installation to the following:
 - a. Aluminum storefronts systems including entrances.
 - b. Aluminum curtain wall systems including entrances.
 - c. Hollow metal doors and frames.
 - d. Wood doors.

- 2. Glazing accessories.

- B. Extent of glass and glazing work is indicated on drawings and schedules.

C. Related Sections:

- 1. Division 7 Section – "Joint Sealants."
- 2. Division 8 Section – "Hollow Metal Doors and Frames."
- 3. Division 8 Section – "Flush Wood Doors."
- 4. Division 8 Section – "Aluminum-Framed Entrances and Storefronts."
- 5. Division 8 Section – "Glazed Aluminum Curtain Wall System."

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Wind Loads: Comply with wind load design requirements specified in Division 8 Section "Aluminum-Framed Entrances and Storefronts."
- B. Thermal Insulating Units: Units shall comply with the requirements of ASTM E2190-08 and certified by Insulating Glass Certification Council (IGCC) or Associated Laboratories, Inc. (ALI).
- C. Tinted, Low-E, Thermal Insulating Glass Performance Characteristics: Values indicated based on *PPG Solarban 60 on Solargray*; 1-inch thickness insulated unit with 1/4-inch thickness lites; coating applied to #2 surface.

- 1. Thermal Transmittance ("U" value winter night): 0.29.

2. Solar Heat Gain Coefficient(SHGC): 0.25.
 3. Visible Light Transmittance: 35-percent.
- D. Tempered Glazing Materials: Complying with CPSC 16-CFR, Part 1201, Category II.
- E. Fire-Rated Glazing: Complying with NFPA 80-2007 and specified fire testing and safety glazing requirements.
1. Fire-rated glazing installed in fire window and door assemblies shall be of materials identical to those passing fire tests complying with the following:
 - a. Door Assemblies:
 - 1) NFPA 252-2003, "Standard Methods of Fire Tests of Door Assemblies," or ASTM E2074-00e1, "Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies."
 - 2) UL 10B-1997, "Standard for Fire Tests of Door Assemblies."
 - 3) UL 10C-1998, "Standard for Positive Pressure Fire Tests of Door Assemblies."
 - b. Window Assemblies:
 - 1) ASTM E2010-01, "Standard Test Method for Positive Pressure Fire Tests of Window Assemblies," or NFPA 257-2000, "Standard on Fire Test for Window and Glass Block Assemblies."
 - 2) UL 9-2000, "Standard for Fire Tests of Window Assemblies."
 2. Fire-rated glazing installed in framed assemblies used as fire barriers shall be of materials identical to those passing fire tests complying with the following.
 - a. ASTM E119-12a, "Standard Test Methods for Fire Tests of Building Construction and Materials," or NFPA 251-2006, "Standard Methods of Tests of Fire Resistance of Building Construction and Materials.
 - b. UL 263-2011, "Standard for Fire Tests of Building Construction and Materials."
 3. Fire rated glazing materials shall meet safety glazing requirements complying CPSC 16-CFR, Part 1201, Category II.
 4. Fire rated glazing shall be Classified or Listed by Underwriters Laboratories (UL) or Intertek Warnock Hersey (WHI) for ratings indicated.
- F. Heat Treatment: Glazing materials, whether in monolithic state or as a lite of a thermal insulating unit, shall be heat treated where required by glass manufacturer's design calculations to resist stress caused by glass orientations, sizes and configurations, heat stress, inherent imperfections, wind loading, glazing conditions, temperature differential, inside window treatments or other conditions affecting breakage probability. Maximum allowable breakage probability at design loads shall be eight (8) lites per thousand for vertical glazing.
- G. Glazing Orientation for Heat-Treated Glass: Orient lites with roll distortion parallel to head and sill members.

1.4 SUBMITTALS

A. Product Data:

1. Submit for each type glazing material and accessory product specified; indicating performance characteristics.
2. Include technical data and instructions for storage and handling procedures.

B. Framing Manufacturer's Approval: Indicate by letter prior to submission of shop drawings for storefront system that an authorized representative of selected storefront manufacturer has reviewed and approved details, including glass bite, clearances and glazing methods.

C. Samples: Submit minimum 12-inch (1'-0") by 12-inch (1'-0") samples of each type of glazing material proposed for use, if requested by Architect.

D. Glass Design Calculations: Submit calculations prepared by glazing material manufacturer indicating recommendations for glass thickness and heat treating of glazing materials as a result of heat stress, building orientation, inside window treatments, shading by exterior building elements or wind loading.

1. Identify factors affecting breakage probability which have been taken into consideration and anticipated by calculations.
2. Calculations are submitted for Architect's information only.

E. Maintenance Data: Include glazing material manufacturer's maintenance data for cleaning and care of each type of glazing material. Submit as part of contract closeout documents.

1.5 QUALITY ASSURANCE

A. Single Source Requirements: Tinted and low emissivity (Low-E) glass types, whether used in a monolithic state or as a lite of a thermal insulating unit, shall each be the products of a single manufacturer.

B. Labels:

1. Glazing shall bear manufacturer's label identifying type, quality and thickness of material. Labels for single thickness annealed float glass, if not available on each lite shall at least be factory applied to shipping crates. All other glazing materials shall be required to bear labels on each lite either temporary or permanent types as required by governing building codes or certification agency where specified.
2. Tempered glass shall have permanent etched or ceramic fired identification on each unit indicating compliance with safety glazing standard. Identification shall be visible in completed installation and oriented in an inconspicuous corner.

1.6 PRE-GLAZING CONFERENCE

A. Prior to beginning glass and glazing work, a pre-glazing conference will be held to review work to be accomplished.

- B. Contractor, storefront and fire-rated storefront supplier and erector, a representative of glass manufacturer, including fire-rated glass manufacturer, a representative of sealant manufacturer, glazing subcontractor and Architect will be present.
- C. Contractor shall notify Architect at least three days prior to time of conference.
- D. Material submitted by Contractor, interfacing of glass and glazing and storefront work, dimensions and tolerances, sealant joint widths and depths will be reviewed.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver glazing materials with manufacturer's identification, glass type, thickness and quality labeled on each piece. Remove no labels until final cleaning.
- B. Store glazing materials indoors in cool, dry area, off floor, equally supported to prevent stress and breakage.
- C. Do not move cases which have been partially unpacked. Unpack glazing materials in accordance with manufacturer's product data for type of material being handled. Stack individual lites as recommended by manufacturer's product data.
- D. Utilize rolling blocks to rotate glazing materials.
- E. Handle insulating units without rotating, warping or "cartwheeling" units. Prevent damage to glazing material or edge seal.

1.8 WARRANTIES

- A. Thermal Insulating Units: Warrant from failure due to loss of edge seal for a period of Ten (10) Years, beginning at Date of Substantial Completion.
- B. Low Emissivity (Low-E) Glass: Low emissivity coating shall be warranted against peeling, cracking, discoloration or deterioration for a period of Ten (10) Years, beginning at Date of Substantial Completion.
- C. Glass Replacement Warranty: Provide warranty covering replacement of damaged glazing materials for any reason other than natural disasters, vandalism or damage resulting from accident or abuse arising out of the Owner's operations for a period of Two (2) Years, beginning at Date of Substantial Completion. Warranty shall include labor and material costs for replacement of glazing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Float Glass Manufacturers; subject to compliance with specified requirements:

1. AGC Glass Company North America, Inc.
2. Guardian Industries Corp.
3. Pilkington NA / Nippon Sheet Glass Company Ltd.
4. PPG Industries, Inc.
5. Viracon, Inc.

B. Acceptable Coated Glass Manufacturers; subject to compliance with specified requirements:

1. AGC Glass Company North America, Inc.
2. Cardinal Glass Industries, Inc.
3. Guardian Industries Corp.
4. Pilkington NA / Nippon Sheet Glass Company Ltd.
5. PPG Industries, Inc.
6. Viracon, Inc.

C. Acceptable Insulating Glass Unit Fabricators; subject to compliance with specified requirements:

1. AGC Glass Company North America, Inc.
2. Cardinal Glass Industries, Inc.
3. Guardian Industries Corp.
4. Oldcastle BuildingEnvelope / Oldcastle, Inc.
5. Pilkington NA / Nippon Sheet Glass Company Ltd.
6. Viracon, Inc.

D. Acceptable Fire-Rated Glass Manufacturers; subject to compliance with specified requirements:

1. AGC InterEdge Technologies, LLC / AGC Glass Company NA, Inc.
2. Nippon Electric Glass Company, Ltd. / Technical Glass Products.
3. Pilkington NA / Nippon Sheet Glass Company Ltd.
4. SAFTI First / Div. O'keeffe, Inc.
5. J.R Four, Ltd. / Technical Glass Products.
6. VETROTECH Saint-Gobain NA.

2.2 PRIMARY AND PROCESSED GLAZING MATERIALS

- A. Clear Float Glass: Meeting ASTM C1036, Type I, Class 1 (clear), Quality q3 (glazing select); minimum 1/4-inch thickness, or as determined by glazing manufacturer's analysis.
- B. Heat-Strengthened Clear Float Glass: Meeting ASTM C 1048, Type I, (transparent), Class 1 (Clear), Quality q3 (Glazing Select), Kind HS (Heated Strengthened), Condition A (Uncoated Glass); thickness as specified or as determined by glazing manufacturer's analysis.
- C. Tempered, Clear Float Glass: Meeting ASTM C 1048, Kind FT (fully tempered), Condition A, Type I, Class 1 (clear), Quality q³ (glazing select); minimum 1/4-inch thickness, except as otherwise indicated.
- D. Tinted, Low-E Float Glass:
 1. Basis of Design: PPG Industries, Inc.; Solarban 60 on Solargray.

2. Material:: Low emissivity, pyrolytic-coated or sputter-coated, tinted, annealed, tempered or heat strengthened float glass meeting specified ASTM standards indicated and as determined by glazing manufacturer's analysis for application required.
 - a. Heat Strengthen, Float Glass: Meeting ASTM C1048, Kind HS (heat strengthen), Condition C, Type I, Class 2 (tinted), Quality q3 (Glazing Select).
 - b. Tempered, Float Glass: Meeting ASTM C1048, Kind FT (fully tempered), Condition C, Type I, Class 2 (tinted), Quality q3 (Glazing Select).
3. Thickness: As determined by glazing manufacturer's analysis.
4. Color: Gray.

2.3 FIRE-RATED GLAZING MATERIALS

A. 20-Minute Fire-Rated Glass:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. AGC InterEdge Technologies, LLC; PyroEdge 20.
 - b. J.R Four, Ltd. (Technical Glass Products); Fireglass 20.
 - c. SAFTI First / Div. O'Keeffe's, Inc.; SuperLite I.
 - d. VETROTECH Saint-Gobain NA, Inc.; SSG Pyroswiss US.
2. Characteristics: Manufacturer's tempered clear monolithic glass designed for application to fire-rated doors; complying with specified fire testing standard (without hose stream test) and safety glazing standard.
 - a. Fire-Rating: 20-minutes.
 - b. Light Transmission: Minimum 87-percent.
 - c. Thickness: Minimum 1/4-inch.

B. 45-Minute, 60-Minute and 90-Minute Fire-Rated Glass:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. InterEdge Technologies; Pyrobel.
 - b. Pilkington NA / Nippon Sheet Glass Company Ltd.; Pyrostop.
 - c. Nippon Electric Company, Ltd. (Technical Glass Products); FireLite Plus.
 - d. VETROTECH Saint-Gobain NA, Inc.; Contraflam.
2. Characteristics: Manufacturer's clear or amber hue glazing units designed for application to fire-rated doors and windows; complying with specified fire testing and safety glazing standard.
 - a. Construction: Multi-layer laminated tempered, ceramic or annealed glass with intumescent interlayers.
 - b. Fire-Ratings: As scheduled on Drawings.
 - c. Light Transmission: Minimum 80-percent.
 - d. Thickness: Manufacturer's standard as tested for ratings specified.

2.4 DECORATIVE GLAZING MATERIALS

A. Decorative Obscure Glass:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. AGC Glass North America, Inc.; Imagin Patterned Glass.
 - b. Guardian Industries, LLC; Textures.
 - c. Pilkington NA / Nippon Sheet Glass Co., Ltd.; Texture Glass.
2. Material: Patterned glass meeting ASTM C 1048, Kind HS (Heated Strengthened), Condition A, Type II, Class 1 (clear), Quality-Q5, Form 3 (patterned), Quality Q5, Finish F1 (patterned one side).
 - a. Pattern: As selected by Architect from manufacturer's full range available patterns.
 - b. Thickness: Minimum 1/4-inch (6 mm) thickness, or greater as required by pattern selected for intended application.

2.5 FABRICATED GLAZING UNITS

- A. Butt Joint Glazing Units: Tempered, clear float glass meeting ASTM C 1048, Kind FT (fully tempered), Condition A, Type I, Class 1 (clear), Quality q³ (glazing select;), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.
 1. Thickness: 3/8-inch.
 2. Butt Edges: Flat ground to produce square edges with slight chamfers at junctions of edges and faces.
- B. Tinted, Low-E, Thermal Insulating Units:
 1. Basis of Design: PPG Industries, Inc.; Solarban 60 on Solargray + clear glass.
 2. Outboard Lite: Tinted, low-E, heat strengthen, float glass as specified; thickness as determined by glazing manufacturer's analysis. Low-E coating applied to No. 2 surface.
 3. Inboard Lite: Clear, heat strengthen float glass as specified; thickness as determined by glazing manufacturer's analysis.
 4. Spacer: Manufacturer's standard steel or aluminum spacer with welded, fused or bent corners and welded or fused splices and joints, filled with desiccant; to provide a 1/2-inch thickness, hermetically sealed, dehydrated air space.
 5. Unit Thickness: 1-inch, minimum.
- C. Tempered, Tinted, Low-E, Thermal Insulating Units:
 1. Basis of Design: PPG Industries, Inc.; Solarban 60 on Solargray + clear glass.
 2. Outboard Lite: Tempered, tinted, low-E, float glass as specified; thickness as determined by glazing manufacturer's analysis. Low-E coating applied to No. 2 surface.
 3. Inboard Lite: Tempered, clear float glass as specified; thickness as determined by glazing manufacturer's analysis.

4. Spacer: Manufacturer's standard steel or aluminum spacer with welded, fused or bent corners and welded or fused splices and joints, filled with desiccant; to provide a 1/2-inch thickness, hermetically sealed, dehydrated air space.
5. Unit Thickness: 1-inch, minimum.

D. Obscure, Tinted, Low-E, Thermal Insulating Units:

1. Basis of Design: PPG Industries, Inc.; Solarban 60 on Solargray + decorative obscure glass.
2. Outboard Lite: Tinted, low-E, heat strengthen, float glass as specified; thickness as determined by glazing manufacturer's analysis. Low-E coating applied to No. 2 surface.
3. Inboard Lite: Heat strengthen, decorative obscure glass as specified; thickness as determined by glazing manufacturer's analysis.
4. Spacer: Manufacturer's standard steel or aluminum spacer with welded, fused or bent corners and welded or fused splices and joints, filled with desiccant; to provide a 1/2-inch thickness, hermetically sealed, dehydrated air space.
5. Unit Thickness: 1-inch, minimum.

2.6 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 70-90 Shore A durometer hardness, meeting ASTM C 864.
- B. Edge Blocks: Neoprene, 60-70 Shore A durometer hardness, meeting ASTM C 864.
- C. Spacers: Neoprene, 40-60 Shore A durometer hardness, meeting ASTM C 864.
- D. Glazing Gaskets for Storefront Systems: Glazing assembly manufacturer's standard extruded or molded neoprene or Ethylene Propylene Diene Monomer (EPDM) gaskets.
- E. Interior Hollow Metal Partition Glazing: Manufacturer's standard resilient glazing beads.
- F. Polyvinyl Chloride Foam Tape: Closed cell foam tape meeting ASTM D1667-05 with pressure-sensitive adhesive on one side.
- G. Fire-Rated Glazing Accessories:
 1. Glazing Gaskets and Tapes: Closed cell polyvinyl chloride (PVC) foam tape, EPDM tape, ceramic glazing tape or other flame resistant gasket material as recommended by fire-rated glazing manufacturer and fire tested with glazing assemblies for specified ratings.
 2. Setting Blocks: Neoprene, EPDM, hardwood or calcium silicate setting blocks as recommended by fire-rated glazing manufacturer and fire tested with glazing assemblies for specified ratings.
 3. Cleaners, Primers and Sealers: Types as recommended by glazing and gaskets manufacturer.

2.7 GLAZING SEALANT

- A. Acceptable Products; subject to compliance with specified requirements:
 - 1. Dow Corning Corp.; 795 Silicone Building Sealant.
 - 2. Pecora Corp.; 895NST.
 - 3. Tremco, Inc.; Spectrum 2.
- B. Characteristics: One part, neutral-curing silicone rubber glazing sealant complying with ASTM C920-05, Type S, Grade NS, Class 50, Use NT.
 - 1. Joint Movement Capability: Minimum plus or minus 50-percent extension and compression.
 - 2. Colors: As selected by Architect from manufacturer's standard full range color selection.
- C. Accessories: Provide primers as required, backer rod and accessories acceptable to sealant manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify compliance with the following requirements prior to beginning glazing work:
 - 1. That framing is anchored in position, plumb and square within 1/8-inch of nominal dimensions indicated.
 - 2. That fastener heads, and other projections are removed from glazing rabbets.
 - 3. That corners and fabricated intersections are sealed and framing is weather-tight.
 - 4. That rabbets at sills weep to outside and rabbets are of sufficient depth and width to receive glazing material and provide the required bite of the glazing material.
 - 5. That wood frames have been prime painted or stained and finished as applicable in accordance with Painting section.
 - 6. That hollow metal frames have received paint finish in accordance with Painting section.

3.2 PREPARATION

- A. Clean glass edges and framing glazing channel of debris and protective coatings immediately prior to glazing. Use material acceptable to framing, glazing material and glazing sealant manufacturers.
- B. Inspect glazing material prior to installation. Eliminate lites having face or edge damage.
- C. Lites of tempered, heat-strengthened, laminated and insulating glass shall not be cut or otherwise altered in the field.

3.3 INSTALLATION REQUIREMENTS

- A. Install glazing materials to obtain air-tight and water-tight installation and to withstand normal temperature changes and wind loads without failure.
- B. Protect glazing material faces and edges during handling and installation.
- C. Size glazing materials for each opening to ensure correct bite on glazing material, without imposing strain, in accordance with manufacturer's product data.
- D. Maintain minimum 1/8-inch bed clearance between glazing material and sash, on both sides, except where greater clearances is required by either glazing material or framing manufacturer.

3.4 GLAZING INSTALLATION

- A. Install glazing materials in accordance with manufacturer's product data and applicable standards, except where more stringent requirements are specified.
- B. Install setting blocks for all glazing materials over six sq. ft. in area.
 - 1. Install at sill rabbet located one quarter of glass width from each corner, but with edge nearest corner not closer than 6-inch from corner, unless otherwise required.
 - 2. Size setting blocks in proportion to glass weight; minimum 4-inch length.
- C. Shim all lites over 100 united inches, inboard and outboard, on all sides using continuous shims, except where gaskets accomplish shimming; unless otherwise specified.
- D. Provide edge blocks at vertical jambs to limit lateral movement of glass. Provide edge blocks in 4-inch minimum lengths. Maintain 1/8-inch clearance between edge of glass and edge block.
- E. Storefront Glazing:
 - 1. Install continuous gasket to exterior side of rabbet with joints located at center and top of frame. Notch gasket at corners to form neat joints.
 - 2. Set glazing material centered in rabbet. Apply gaskets to interior side of rabbet, with corners mitered.
 - 3. Oversize gaskets to allow compressing of miter joints to provide positive seal.
- F. Curtain Wall Glazing:
 - 1. Install gasket to interior stop with mitered corners.
 - 2. Set glazing material centered in rabbet. Apply exterior gasket, with corners mitered.
 - 3. Oversize gaskets to allow compressing of miter joints to provide positive seal.
- G. Interior Hollow Metal Partition Glazing: Glaze using specified glazing beads in accordance with manufacturer's instructions.

- H. Interior Channel Glazing: Glaze using specified polyvinyl chloride foam tape applied to both sides of glazing pocket. Install tape with tight butted joints. Compress tape approximately 30-percent. Set glazing material centered in rabbet.
- I. Interior Vertical Butt Joint Glazing: Set glazing units with uniform joints plumb and with glass edges aligned. Install glazing with 3/8-inch, maximum, butt joint width complying with GANA recommendations unless otherwise directed by sealant manufacturer's requirements.
 - 1. Seal vertical butt joint conditions using clear silicone glazing sealant. Comply with glazing material manufacturer's product data and recommendations for joint width and depth.
 - a. Mask edges of glass to confine sealant to joints and to avoid contact to face of glazing.
 - b. Tool sealant joints neat to provided slight concave surface using tool agent recommended by sealant manufacturer.
 - 2. After tooled sealant joints have set, remove masking from glass and clean surfaces free of sealant material.
- J. Fire-Rated Glazing: Comply with fire-rated glazing manufacturer's instructions and NFPA 80 requirements for installation in fire doors and windows or framed openings.
 - 1. Install glazing materials of ratings scheduled for fire-rated doors and framed openings.
 - 2. Install glazing so that permanent labels are positioned in an inconspicuous corner for visual inspection by building official.
- K. Glazing Sealant Installation: Comply with applicable provisions of Division 7 "Joint Sealants" section. Prevent filling of weep holes with sealant.

3.5 PROTECTION AND CLEANING

- A. For glazing materials subject to damage during construction, protect from breakage by attachment of crossed streamers to framing. Do not mark on surfaces.
- B. Remove and replace broken, cracked, chipped or otherwise damaged glazing materials and materials not meeting specified design requirements prior to Date of Substantial Completion.
- C. Final cleaning: Just prior to Date of Substantial Completion, clean glass inside and out.
 - 1. Clean using pre-tested detergent and water. Flush with clean water.
 - 2. Repair or replace work which cannot be cleaned or which has been damaged during construction operations.

END OF SECTION 08 80 00

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

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. Section Includes:

1. Nonload-bearing steel framing members for interior gypsum board assemblies.
2. Gypsum board attached to steel framing including the following board types:
 - a. Regular gypsum board.
 - b. Type X or type C gypsum board for fire rated assemblies.
 - c. Sag-resistant gypsum ceiling board.
 - d. Moisture and mold-resistant gypsum board.
 - e. Abuse-resistant gypsum board.
 - f. Glass-mat, water-resistant gypsum backing board.
3. Suspended drywall furring system.
4. Gypsum shaft-wall systems, including liner panels.
5. Sound Insulation.

B. Related Sections:

1. Division 4 Section – "Adhered Stone Masonry Veneer."
2. Division 5 Section - "Cold-Formed Metal Framing."
3. Division 6 Section - "Rough Carpentry."
4. Division 7 Section – "Firestopping."
5. Division 8 Section – Hollow Metal Doors and Frames.
6. Division 8 Section – "Access Doors and Frames."
7. Division 9 Section – "Acoustical Panel Ceilings"
8. Division 9 Section – "Tiling."
9. Division 9 Section - "Painting."
10. Division 22 – Plumbing sections.
11. Division 23 - Heating, Ventilating, and Air Conditioning sections.
12. Division 23 – Electrical sections.

1.3 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Nonload-Bearing Steel Framing Members: Framing for interior gypsum board assemblies shall be in accord with manufacturer's product data for heights and conditions of use complying with the following maximum allowable deflection.
 - 1. Framing supporting gypsum board receiving paint, wallcovering or similar flexible finishes: $L/240$.
 - 2. Framing supporting gypsum board or cement board receiving ceramic tile, adhered stone veneer, plaster, and similar rigid finishes: $L/360$.
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
 - 1. Comply with fire rated assembly designs indicated or those included in the following publications:
 - a. Gypsum Association: GA-600 "Fire Resistance Design Manual," current edition.
 - b. Underwriters Laboratories, Inc.: UL "Fire Resistance Directory," current edition.
 - 2. Fire-rated assembly designs by other testing and inspecting agency will be acceptable subject to approval of authorities having jurisdiction.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature, including installation instructions, indicating compliance with specified requirements.
 - 1. Mark literature to indicate only those products proposed for use.
 - 2. Include data for fire-rated and sound-rated partitions. Include details for acoustical sealant installation.
 - 3. Include technical data and manufacturer's details for shaftwall system.
 - 4. Include technical data and manufacturer's details for suspended drywall furring system.
- B. Product Certificates: Submit certification signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.6 QUALITY ASSURANCE

- A. Single-Source Limitations:

1. Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
2. Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
3. Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.8 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Room Temperatures:
 1. For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C).
 2. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before application and continuously after until dry.
 3. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with requirements, provide products for each of the indicated materials by one of the listed manufacturers:
 1. Steel Framing and Furring:
 - a. CEMCO / California Expanded Metal Products Co.
 - b. ClarkDietrich Building Systems, LLC.

- c. Marino Ware / Div. Ware Industries, Inc.
- d. The Steel Network, Inc.

2. Gypsum Board and Related Products:

- a. CertainTeed Corporation.
- b. G-P Gypsum Corporation / Georgia-Pacific Company.
- c. Continental Building Products, Inc.
- d. National Gypsum Company.
- e. USG Corporation.

2.2 STEEL FRAMING FOR INTERIOR WALLS, PARTITIONS AND SOFFITS

- A. Metal Finish for Framing : Provide steel framing members with protective finish complying with the following requirements:
- 1. Manufacturer's standard corrosion-resistant coating for interior applications except as otherwise specified.
 - 2. Protective coating meeting ASTM A 653, G 40 hot-dip galvanized coating for framing members attached to and within 10-feet of exterior walls and where supporting ceramic tile finishes.
- B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch wide minimum lip (return), and complying with the following requirements:
- 1. Thickness: Provide minimum thickness of base (uncoated) metal as specified below.
 - a. 0.0179 inch (25 gauge), minimum, unless otherwise indicated.
 - b. 0.0329 inch (20 gauge) minimum, for applications as follows:
 - 1) For head runner, sill runner, jamb, and cripple studs at door and other openings.
 - 2) In locations to receive abuse-resistant gypsum board.
 - 3) In locations to receive glass-mat, water-resistant, gypsum backing board for tile finishes.
 - 4) In locations to receive cementitious backer board for adhered stone masonry veneer finishes.
 - 2. Depth: 3-5/8 inches, minimum, unless otherwise indicated.
- C. Deflection Tracks: Either of the following types specified fabricated from runners meeting ASTM C 645.
- 1. Single Long-Leg Runner System: Top runner with 2-inch deep flanges fabricated from same material as studs, minimum 0.0329-inch (20-gauge) thickness, installed with studs friction fit into top runner and with continuous bridging located within 12-inches of the top of studs to provide lateral bracing.

2. Double-Runner System: Nested top runners fabricated from same material as studs with inner runners having 2-inch deep flanges, minimum 0.0269-inch (22-gauge); outer runner sized to friction fit over inner runner fastened to studs.
- D. Steel Rigid Furring Channels: ASTM C 645, hat shaped section, complying with the following requirements:
 1. Thickness: 0.0179 inch (25 gauge) minimum base (uncoated) metal thickness, unless otherwise indicated.
 2. Depth: 7/8 inch unless otherwise indicated.
- E. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch (25 gauge), and depth required to fit insulation thickness or as indicated.
- F. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, fabricated from steel sheet complying with ASTM A 653 or ASTM A 568 to form 1/2-inch deep channel of the following configurations:
 1. Single-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single-slotted leg (web); 1-1/2 inch face width.
 2. Double-Leg Configuration: Hat-shaped channel, with 1-1/2 inch wide face connected to flanges by double-slotted or expanded-metal legs (webs).
- G. Steel Channel Bridging: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch wide flanges, 1-1/2 inches deep, 475 lb/1000 lineal feet, unless otherwise indicated.
- H. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing complying with ASTM A 653 or ASTM A 568, length and width as indicated; 0.0598-inch (16 gauge) minimum base metal (uncoated) thickness.

2.3 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: Provide components of sizes indicated but not less than that required to comply with ASTM C 754 for conditions indicated.
- B. Cast-in-Place and Post installed Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires, and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.
 1. Cast-in-place type designed for attachment to concrete forms.
 2. Expansion anchor.
- C. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without

failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190 conducted by a qualified independent testing agency.

- D. Wire Ties: ASTM A 641, Class 1 zinc coating, soft temper, 0.062 inch thick.
- E. Wire Hangers For Interior Ceilings: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- F. Rod Hangers: Minimum 1/4-inch diameter, galvanized, threaded cold-drawn mild steel.
- G. Channels: Cold-rolled steel, 0.0598-inch minimum thickness of base (uncoated) metal and 7/16-inch wide flanges, and as follows:
 - 1. Carrying Channels: 2 inches deep, 590 lb/1000 lineal feet, unless otherwise indicated.
 - 2. Furring Channels: 3/4 inch deep, 300 lb/1000 lineal feet, unless otherwise indicated.
 - 3. Finish For Interior Suspension System: Manufacturer's standard corrosion resistant zinc coating.
- H. Steel Studs for Furring Channels: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
 - 1. Thickness: 0.0329 inch (20 gauge), unless otherwise indicated.
 - 2. Depth: 2-1/2 inches, unless otherwise indicated.
 - 3. Protective Coating: Manufacturer's standard corrosion-resistant coating unless indicated otherwise.
- I. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth of 7/8-inch, and minimum thickness of base (uncoated) metal as follows:
 - 1. Thickness: 0.0329 inch (20 gauge), unless otherwise indicated.
 - 2. Protective Coating: Manufacturer's standard corrosion-resistant coating unless indicated otherwise.

2.4 SUSPENDED DRYWALL FURRING SYSTEM

- A. Acceptable manufacturers; subject to compliance with specified requirements:
 - 1. Armstrong World Industries, Inc.
 - 2. Chicago Metallic Corp.
 - 3. USG Interiors, Inc.
- B. Characteristics:
 - 1. Structural Classification: Meeting ASTM C635, Heavy Duty classification.
 - 2. System Performance: Suspension system components, hangers and fastening

devices shall be capable of supporting loads of light fixtures, ceiling grilles and gypsum board with a maximum deflection of 1/360 of the span, tested in accord with ASTM C635.

3. Material: Components fabricated from minimum 0.020-inch thickness, galvanized cold-rolled steel.
4. Suspension System Components:
 - a. Main Runners and Cross Tees: Double web tees with factory punched cross tee slots, hanger holes, and interlocking end tab couplings. Tees shall be of fabrication with either wide knurled metal face flanges or capped face flanges as per manufacturer's system designed for screw attachment of gypsum board panels.
 - b. Cross Furring Channels: Manufacturer's hat-shaped section having knurled metal flange face with end tabs designed for interlocking with main runners.
 - c. Edge Tracks: Channel or angle shaped tracks in manufacturer's standard size; same material as runners and tees.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch (12-gauge) diameter wire.
- D. Accessories: Provide manufacturer's assorted clips, tees, struts, stabilizers, bracings and components to construct ceiling transitions, curves, offsets and bulkheads indicated.

2.5 GYPSUM BOARD PRODUCTS

- A. General:
 1. Lengths: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
 2. Widths: Provide gypsum board in widths of 48-inches.
- B. Gypsum Wallboard: Meeting ASTM C 1396 and as follows:
 1. Types:
 - a. Regular Gypsum Board: Provide for vertical surfaces, unless otherwise indicated.
 - b. Type X or Type C Gypsum Board: Provide as required by fire-resistance-rated assemblies indicated on Drawings.
 - c. Sag-Resistant Gypsum Ceiling Board: Provide for ceiling applications.
 2. Edges: Tapered.

3. Thickness: As indicated on drawings.
- C. Moisture and Mold Resistant Gypsum Board: Meeting ASTM C 1396, with moisture- and mold-resistant core and paper surfaces.
1. Mold Resistance: No mold growth when tested per ASTM D 3273 and having a score of 10 as rated according to ASTM D 3274.
 2. Long Edges: Tapered.
 3. Thickness: As indicated on drawings.
- D. Abuse-Resistant Gypsum Board:
1. Acceptable Products; subject to compliance with specified requirements:
 - a. CertainTeed Corporation; Extreme Abuse.
 - b. Continental Building Products, Inc.; Protecta® AR 100 Type X.
 - c. National Gypsum Company; Hi-Abuse XP Fire-Shield Wallboard.
 2. Characteristics: Abuse-resistant, fiberglass-reinforced non-combustible, high density, gypsum panels meeting ASTM C1396, type 'X' core and surfaced with heavy duty, abrasion and indentation resistant, paper facing.
 - a. Abuse-Resistance Classification: Complying with ASTM C1629 for not less than the classification level specified for indicated properties.
 - 1) Soft Body Impact Resistance: Level 2.
 - 2) Hard Body Impact Resistance: Level 1.
 - 3) Surface Abrasion Resistance: Level 3.
 - 4) Surface Indentation Resistance: Level 1.
 - b. Fire Performance: Tested in accord with ASTM E 119 for use in fire resistance design assemblies.
 - c. Combustibility: Non-combustible gypsum core when tested in accord with ASTM E 136.
 - d. Edges: Long sides tapered.
 - e. Thickness: 5/8-inch.
- E. Glass-Mat, Water-Resistant Gypsum Backing Board:
1. Acceptable Product; subject to compliance with requirements:
 - a. CertainTeed Corporation; Diamondback GlasRoc Tile Backer Type X.
 - b. G-P Gypsum / Georgia Pacific Company; DensShield Fireguard Tile Backer.
 - c. National Gypsum Company; Gold Bond eXP Tile Backer.
 - d. United States Gypsum Co.; Durock Brand Glass-Mat Tile Backerboard.
 2. Characteristics: Coated glass-mat, water-resistant backing panel complying with ASTM C1178-11; composed of non-combustible, water-resistant, type X special fire resistant gypsum core, surfaced with glass mats and with water-resistant

acrylic coating on one surface.

- a. Thickness: 5/8-inch; unless otherwise indicated.
- b. Size: 48-inches (4-ft.) width by manufacturer's standard lengths.

2.6 GYPSUM SHAFT-WALL SYSTEMS

- A. Shaftwall Assemblies: Manufacturer's standard non-load bearing gypsum board partition assemblies designed for enclosing shafts and erection from one side; system consisting of gypsum liner panels, metal framing members and gypsum wallboard face panels on exposed surfaces.
 1. Fire Resistive Rating: As indicated on drawings.
 2. Sound Transmission Class (STC): As indicated on drawings.
- B. Gypsum Liner Panels: Manufacturer's proprietary noncombustible gypsum panels meeting ASTM C1396, Type X core, with moisture-resistant paper facing.
 1. Size: 24-inches (2'-0") width by manufacturer's standard lengths required to fit shaft wall construction.
 2. Thickness: 1-inch.
 3. Edges: Square, eased or beveled edges along panel length.
- C. Non-Load-Bearing Steel Framing: Manufacturer's standard profiles, shapes and sizes for studs, runners and tracks designed to accept gypsum liner panels; complying with ASTM C 645 requirements for metal material thickness, unless otherwise indicated.
 1. Structural Design Properties: Structural performance and sectional properties conforming with AISI SG02-1, "North American Specification for the Design of Cold-Formed Steel Structural Members."
 2. Protective Coating: Complying with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.
 3. Metal Framing Members: Manufacturer's standard stud profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
 - a. Stud Depth: As indicated on drawings.
 - b. Sizes and Gauges: As required by manufacturer's product data complying with ASTM C 754 for conditions indicated to withstand a pressure load of 5.0 psf with a maximum deflection of L/240.
 4. Runner Tracks: Manufacturer's standard J-profile track with long-leg length as standard with manufacturer, but at least 2 inches length and in depth matching studs; 0.0220 inch (24 gauge) minimum base-metal thickness.

2.7 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 1. Material: Formed metal of steel sheet zinc coated by hot-dip process or rolled zinc

or plastic:

2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
 - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
 - d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
 - e. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.

2.8 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated. Use pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.
- C. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.
 3. For filling joints and treating fasteners of glass-mat water-resistant gypsum backing board installed to receive ceramic tile finish, use formulation recommended by glass-mat water-resistant gypsum board manufacturer.
 4. For topping compound, use sandable formulation.
- D. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products or ready-mixed formulation complying with the following requirements for intended use.
 1. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 2. Topping compound formulated for fill (second) and finish (third) coats.
 3. All-purpose compound formulated for both taping and topping compounds.

2.9 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant:

1. Acceptable Products:

- a. Pecora Corp., AIS-919 Acoustical and Insulation Latex Sealant.
- b. Tremco, Inc., Acoustical Sealant.
- c. Specified Technologies, Inc.; SpecSeal Smoke N' Sound Acoustical Caulk.
- d. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Type: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 83.

- a. Product shall effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- b. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.10 SOUND INSULATION

A. Mineral Fiber Sound Attenuation Batts:

1. Acceptable Products; subject to compliance with specified requirements:

- a. Fibrex Insulations, Inc.; Sound Attenuation Fire Batt Insulation (SAFB)
- b. IIG MinWool, LLC; MinWool-1200 Sound Attenuation Fire Batt.
- c. Rockwool Manufacturing Co., Delta SA-Fire Board.
- d. Thermafiber, Inc.; Thermafiber Sound Attenuation Fire Blankets (SAFB).

2. Type: Unfaced, mineral fiber blankets meeting ASTM C665, Type I and ASTM C612.

- a. Density: Minimum 2.5 pcf.
- b. Combustibility: Non-combustible when tested in accord with ASTM E136.
- c. Surface burning characteristics: Meeting flame spread and smoke developed index specified when tested in accord with ASTM E84.
- d. Flame spread index: Not less than 15.
- e. Smoke developed index: Not more than 5.
- f. Thickness: As indicated on drawings or as required to meet sound rated assembly design.
- g. Size: Manufacturer's standard widths to friction fit between framing members by lengths as required.

B. Fiberglass Sound Batts:

1. Acceptable Products; subject to compliance with specified requirements:

- a. CertainTeed Corporation; CertaPro AcoustaTherm Batts.
 - b. Johns Manville Corporation/Building Insulation Division; Sound Control Batts.
 - c. Knauf Insulation; QuietTherm QT Batts.
 - d. Owens-Corning Fiberglas Corporation; Sonobatts Insulation.
2. Type: Unfaced, fiberglass blanket insulation meeting ASTM C665, Type I.
- a. Surface burning characteristics: Meeting flame spread and smoke developed index specified when tested in accord with ASTM E84.
 - 1) Flame spread index: Not less than 25.
 - 2) Smoke developed index: Not more than 50.
 - b. Thickness: As indicated on drawings or as required to meet sound rated assembly design.
 - c. Size: Manufacturer's standard width equal to spacing of framing members.

2.11 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.
- C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
- D. Fasteners for Gypsum Board:
 1. Provide steel drill screws complying with ASTM C 1002 for the following applications:
 - a. Fastening gypsum board to steel members less than 0.033-inch thick.
 - b. Fastening gypsum board to wood members.
 - c. Fastening gypsum board to gypsum board.
 2. Provide steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112-inch thick.
- E. Laminating Adhesive: Special adhesive or joint compound as recommended by manufacturer for laminating gypsum panels. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine panel products before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
- B. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.3 STEEL FRAMING INSTALLING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with manufacturer's recommended details.

1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 2. Where partition framing and wall furring abut structure, except at floor.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Suspend ceiling hangers from building structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.
 5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to steel deck tabs.
 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Sway-brace suspended steel framing with hangers used for support. Comply with building code requirements for seismic bracing.
- C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
1. Wire Hangers: 48 inches on center.
 2. Carrying Channels (Main Runners): 48 inches on center.
 3. Furring Channels (Furring Members): 16 inches on center.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet as measured both lengthwise on each member and transversely between parallel members.

- E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

3.5 SUSPENDED DRYWALL FURRING SYSTEM INSTALLATION

- A. Install suspension system in accord with manufacturer's product data and ASTM C754.
- B. Space hangers at 48-inches (4-ft.) on center, maximum, in each direction. Secure to building structure by wire typing to structural framing members, fastener clip devices or inserts.
- C. Tie hanger wires wrapped minimum three time tight around itself, turning ends upwards.
- D. Install additional hangers at end of each suspension member and at each corner of lighting fixtures.
- E. Locate hangers plumb in relation to main tees and to avoid contact with insulation covering ducts and pipes. Do not pass hangers through ducts. Alter spacing of hangers or splay hangers to avoid ducts and other obstructions, but do not exceed maximum allowable ceiling areas to be supported by each hanger. Offset horizontal forces of splayed hangers by counter-splaying or bracing. Splay wires no more than 5-inches in 4-ft. vertical drop.
- F. Space main tees at 48-inches (4-ft.) on center, maximum perpendicular to structural framing. Space cross tees at 2-ft. (24-inches) on center., perpendicular to main tees to form 24-inch by 48-inch (2-ft by 4-ft) grid system.
- G. Level and square suspension system within specified tolerances.
- H. Where grid system exists in an unrestrained condition, brace back to building structure using hanger wire, main tee or carrying channel braces spaces at 48-inches (4-ft.) on center, maximum.
- I. Construct offsets, bulkheads and ceiling transitions using manufacturer's clips, struts, bracing and devices designed to provide for a secure rigid and stable installation.
- J. Install edge tracks where suspension components intersects with vertical surfaces. Attach to substrates with mechanical fasteners. Cut suspension members as required to fit into tracks.
- K. Do not load suspension system to exceed specified deflection limit.

3.6 INSTALLING STEEL FRAMING FOR INTERIOR WALLS, PARTITIONS AND SOFFITS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening

surfaces do not vary more than 1/8-inch from the plane formed by the faces of adjacent framing.

- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. Cut studs 1/2-inch short of full height to provide perimeter relief.
 - 2. For sound insulated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Terminate partition framing at suspended ceilings where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated.
 - 1. Single-Layer Construction: Space studs 16-inches on center, unless otherwise indicated.
 - 2. Multilayer Construction: Space studs 24-inches on center, unless otherwise indicated.
 - 3. Moisture and Mold Resistant Gypsum Board Construction: Space studs 16-inches on center, unless otherwise indicated.
 - 4. Abuse-Resistant Gypsum Board Construction: Space studs 16-inches on center, unless otherwise indicated.
 - 5. Cement Board Construction: Space studs 16-inches on center, unless otherwise indicated.
- F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1. Install two (2) studs at each jamb, unless otherwise indicated.
 - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.7 SHAFTWALL SYSTEM INSTALLATION

- A. Install shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 for installing steel framing except comply with framing spacing indicated.
- B. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.
 - 1. At elevator hoistway entrance door frames, provide jamb struts on each side of door frame.
 - 2. Where handrails attach direct to gypsum board shaft-wall assemblies, install 16 gauge (0.0598-inch) thickness galvanized steel flat reinforcing strap or plate positioned and secured behind at least one gypsum board face-layer panel.
- C. Integrate stair hanger rods with gypsum board shaft-wall assemblies by locating cavity of assemblies where required to enclose rods.
- D. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.
- G. In elevator shafts where gypsum board shaft-wall assemblies cannot be positioned within 4 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 1/2-inch or 5/8-inch thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).
 - 1. Slope cant panels at least 75-degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches on center with screws fastened to shaft-wall framing.
 - 2. Where steel framing is required to support gypsum board cants, install framing at 24-inches on center and extend studs from the projection to shaft-wall framing.
- H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8-inch from the plane formed by faces of adjacent framing.

3.8 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.

- B. Install sound insulation , where indicated, prior to installing gypsum panels unless insulation is readily installed after panels have been installed on one side. Refer to the "Sound Insulation" article in this specification section.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16-inch of open space between panels. Do not force into place.
- E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32-inches wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- I. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
 - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffer, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffer, joists, and other structural members; allow 1/4-inch to 3/8-inch wide joints to install sealant.
- K. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4-inch to 1/2-inch wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- L. Where sound insulated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a

continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
1. Space screws a maximum of 12-inches on center for horizontal applications
 2. Space fasteners in panels that are tile substrates a maximum of 8-inches on center.

3.9 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
 - b. At high walls, install panels horizontally.
- B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints. Stagger joints on opposite sides of partitions.
- C. Single-Layer Fastening Methods: Apply gypsum panels to supports fastened with screws.
- D. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:
1. At fire rated partitions Fasten both base layers and face layers separately to supports with screws.
 2. At all other locations, fasten base layers with screws and face layer with adhesive and supplementary fasteners.
- E. Direct-Bonding to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- F. Tile Backing Board Application: Install specified glass-mat, water-resistant gypsum backing board as a substrate to receive ceramic wall tile and similar rigid applied wall finishes. Comply with tile installation method specified in Division 9 Section "Tiling" for metal framing and gypsum backing board.
1. Comply with manufacturer's written installation instructions and install at

- locations indicated to receive wall tile.
2. Install with 1/4-inch gap where panels abut other construction or penetrations.

3.10 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 3. Install U-bead where indicated.
- D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

3.11 FINISHING GYPSUM BOARD ASSEMBLIES:

- A. Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Levels of Gypsum Board Finish: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated.
 1. Level 1 for ceiling plenum areas and concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies. Embed tape at joints.
 2. Level 2 where gypsum board panels form substrates for ceramic tile and where indicated. Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
 3. Level 4 for gypsum board to receive flat paint finish, at surfaces that will be exposed to view, and for all other locations not otherwise specified. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners,

- and trim flanges.
4. Level 5 for gypsum board to receive gloss or semi-gloss paint finish, including epoxy paints. Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface

- E. Finish glass-mat water-resistant gypsum backing board forming base for ceramic tile to comply with ASTM C 840 and gypsum board manufacturer's directions for treatment of joints behind tile.

3.12 SOUND INSULATION

- A. Install to gypsum drywall partitions after first layer of gypsum board is installed.
- B. Install sound insulation with snug joints in accord with manufacturer's instructions to secure insulation in place.
- C. Where installed above ceilings, lay insulation flat. Install unfaced batts over suspended ceilings at partitions in width that extends on either side of partition as indicated.

3.13 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed.
 1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80-percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.
- B. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

3.14 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- C. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 21 16

SECTION 09 30 00 - TILING

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. Section Includes:

1. Porcelain tiles.
2. Glazed wall tiles.
3. Crack isolation membrane for thin-set tile installations.
4. Tile setting materials and accessories.

- B. Related Sections:

1. Division 3 Section - "Cast-In Place Concrete."
2. Division 9 Section – "Gypsum Board Assemblies."
3. Division 9 Section – "Joint Sealants."
4. Division 22 Plumbing sections.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature and installation instructions for each type tile and for manufactured mortars, grouts, crack isolation membrane, sealants and accessories. Include proportioning and mixing instructions for mortars, grouts, and latex additives.

- B. Samples:

1. Tile: Submit minimum 12-inch by 12-inch (1-ft. by 1-ft.) size sample panels for each type tile in colors and textures selected. Prepare samples consisting of minimum four actual size tile units mounted on plywood or hardboard panels with grouted joints in width, color and material specified.
2. Trim and Accessories: Submit actual size sample of each type trim and accessory required.
3. Crack isolation membrane: Submit 12-inch (1-ft.) square sample of actual membrane material.
4. Edge Protection and Transition Accessories: Submit minimum 6-inch length sample of actual accessory to be used.
5. Sealant: Submit actual sealant material sample in selected color(s) for Architect's approval.

- C. Master Grade Certificates: Submit certificates for each shipment and type tile indicating that materials conform with ANSI A137.1.
 - 1. Certificates shall indicate grade and types of tile, manufacturer's name, package identification numbers, date of shipment, name and location of project.
 - 2. Tile manufacturer shall sign and issue certificates at time of shipping.
- D. Setting and Grouting Material Approval: Submit letter from mortar, grout and latex additive manufacturer approving products proposed for use in accordance with setting and grouting material requirements specified herein.
- E. Maintenance Data: Submit manufacturer's maintenance instruction for care and cleaning of each type tile. Indicate recommended cleaning products, methods and maintenance procedures. Include as part of Contract Closeout documents

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall have minimum Five (5) years' experience in satisfactory completion of tile installations of similar nature and scope as required for this project. If requested by Architect, submit evidence of satisfactory installations of similar work completed within the past three years; provide project list with references indicating architect and owner contact information.
- B. Setting and Grouting Material Requirements: Setting mortars, grouts and latex additives shall be products of a single manufacturer. Products shall be as recommended and approved in writing by manufacturer, meeting specified requirements, for installation and substrate conditions indicated.
- C. Allowable Tolerances: Finished work shall be plumb, level and true to line within $\pm 1/4$ -inch in an undivided space and $\pm 1/16$ -inch maximum in a running foot, non-cumulative.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original containers with labels intact and legible, identifying brand name and contents.
 - 1. Tile cartons shall be sealed with labeled grade marking by manufacturer complying with ANSI A137.1, with grade seals unbroken.
 - 2. Manufactured mortars, and grouts shall bear hallmarks certifying compliance with specified standards.
- B. Store tile in original cartons with grade seals unbroken. Protect stored materials from damage or contamination from weathering, freezing, foreign matter, and other detrimental conditions.
- C. Handle tile materials to prevent from cracking, chipping, breaking and other damages. Damaged tile shall not be permitted for installation and removed from site. Replace damaged materials at no additional cost to Owner.

1.6 PROJECT CONDITION

A. Environmental Requirements:

1. Maintain temperatures above 50-degrees F. but not exceeding 100 -degrees F. in areas to receive tile during installation and minimum seven (7) days after completion unless otherwise directed by manufacturer's instruction.
2. If field mixed mortars and grouts are used, prepare mixtures when ambient temperatures are above 50-degrees F.
3. Comply with manufacturers recommended temperature conditions for factory-mixed mortars and grouts. Do not mix or use when temperature conditions are below minimum requirements.
4. Substrate temperatures shall be minimum 50-degrees F. and rising at time of installation unless otherwise directed by manufacturer's instructions. Do not apply setting materials to surfaces that contain frost.

B. Protection:

1. Provide barricades or protective methods to prevent traffic on tiled floor areas during installation and afterwards until materials are set firm.
2. Prohibit traffic on tiled floors for minimum seven days after grouting is completed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Tile Manufacturers; subject to compliance with specified requirements:

1. American Olean Tile Company.
2. Concept Surfaces, LLC.
3. Crossville Inc.
4. Dal-Tile Corporation.
5. Florim USA / Florim Ceramiche S.P.A.

2.2 CERAMIC TILE

A. Basis of Design: Tile products are as schedule on drawings and shall serve as the basis of design.

1. Tile products of similar design, construction, material composition, size, color, finish and quality by other acceptable manufacturers may be submitted for Architect's acceptance.
2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of manufacturer's product data, material certificates, test reports and samples.

B. Porcelain Tiles:

1. Type: Impervious, porcelain paver meeting ANSI A137.1.
2. Nominal Face Size: As selected by Architect from manufacturer's standard, unless otherwise indicated on drawings.
3. Thickness: 9 mm (3/8-inch), nominal.
4. Edges: Cushion or Square.
5. Color: As indicated on Drawings.
6. Base and Trim Shapes: Provide 6-inch high coved base, including bullnose and corner units as required; matching porcelain tile in color, size and thickness.

C. Glazed Wall Tile:

1. Type: Non-vitreous tile meeting ANSI A137.1; semi-gloss or matte glazed.
2. Nominal Face Size: As selected by Architect from manufacturer's standard, unless otherwise indicated on drawings.
3. Thickness: 1/4-inch nominal.
4. Edges: Cushion.
5. Color: As indicated on Drawings.
6. Base and Trim Shapes: Matching wall tile in color and size for thin-set installation method. Include coved base units, bullnose caps, beads and corner units, as required.

2.3 CRACK ISOLATION MEMBRANE FOR THIN-SET TILE INSTALLATION

- A. Provide specified chlorinated-polyethylene-sheet membrane or fabric-reinforced, modified-bituminous sheet membrane for thin-set tile installation.

B. Chlorinated-Polyethylene-Sheet Membrane:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. Dal-Tile Corporation; Dal-Seal CIS.
 - b. Noble Company (The); Nobleseal CIS.
2. Material: Non-plasticized, chlorinated polyethylene composite sheet membrane faced on both sides with high-strength, nonwoven polyester fabric, for adhering to latex-portland cement mortar and complying with ANSI A118.12.
 - a. Thickness: 0.030-inch (30-mils) nominal.
 - b. Sheet Size: Manufacturer's standard maximum available width and length to minimize joints and seams.

C. Fabric-Reinforced, Modified-Bituminous Sheet Membrane:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. Custom Building Products; Crack Buster Pro Crack Prevention Mat Underlayment.
 - b. Mapei Corporation; Mapeguard 2.
 - c. National Applied Construction Products, Inc.; ECB Anti-Fracture Membrane.

2. Material: Self-adhering, modified-bituminous sheet membrane with fabric reinforcement facing laminated to one side, designed for bonding to latex-portland cement mortar and complying with ANSI A118.12.
 - a. Thickness: 0.040-inch (40 mils), nominal.
 - b. Sheet Size: Manufacturer's standard maximum available width and length to minimize joints and seams.
- D. Installation Accessories: Provide manufacturer's standard solvents, adhesives and accessories as required for complete installation.

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. Custom Building Products; MegaLite Crack Prevention Mortar.
 - b. Laticrete International, Inc.; 254 Platinum.
 - c. Mapei Corporation, Ultraflex 3.
2. Type: Prepackaged premium high bond strength, polymer modified dry-mortar mix meeting ANSI A118.15, composed of portland cement, graded aggregates and dry, redispersible, vinyl acetate or acrylic additives formulated for job-mixing with only water. Mortar shall be non-sag formulation designed for floor and wall installations and acceptable for applications in exterior and interior environments.

2.5 GROUT MATERIALS

A. Polymer Modified Cement Grout:

1. Acceptable Products; subject to compliance with specified requirements:
 - a. Custom Building Products; Prism Ultimate Performance Grout.
 - b. Laticrete International, Inc.; Permacolor Grout.
 - c. Mapei Corporation; Ultracolor Plus Grout.
2. Type: Factory-prepared, polymer modified, sanded grout meeting ANSI A118.7; composed of portland cement or aluminate cement, graded aggregates, color-fast mineral oxide pigments, additives and dry, redispersible, latex/polymer powder formulated for job-mixing with only water.
3. Color: As selected by Architect from manufacturer's standard colors.

2.6 CONTROL AND EXPANSION JOINT MATERIALS

A. Sealant:

1. Acceptable Products; subject to compliance with specified requirements:

- a. BASF Corporation; MasterSeal NP 2.
 - b. Pecora Corp., Dynatrol II.
 - c. Tremco, Inc.; Dymeric 240 or 240FC.
 2. Characteristics: Two-part, polyurethane-based sealant with separate pre-packaged pigmented concentrate color additive; meeting ASTM C920, Type M, Grade NS, Class 25; colors matching grout as selected by Architect.
- B. Accessories:
1. Primer: Type recommended by sealant manufacturer.
 2. Backup material: Flexible, non-compressive foam type as recommended by sealant manufacturer.
 3. Divider strips: Type acceptable to sealant manufacturer.

2.7 EDGE PROTECTION AND TRANSITIONS ACCESSORIES

- A. Acceptable Manufacturer: Schluter Systems, L.P.
- B. Types: Satin natural anodized extruded aluminum or stainless steel of style and dimensions to suit application, designed for setting with tile mortar or adhesive.
- C. Locations: Provide trim accessories as indicated on Drawings, or as recommended by manufacturer, for the following locations and conditions required for the Project.
1. Open edges of floor tile.
 2. Transition between floor finishes of different heights.
 3. Thresholds at door openings.
 4. Expansion and control joints, floor and wall.
 5. At corner seam where tile is applied to a vertical surface.

2.8 CLEANING MATERIALS

- A. Tile and Grout Cleaners: Non-corrosive, non-acid based, neutral type as recommended and acceptable to tile and grout manufacturers; compatible with installed materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate conditions to verify that surfaces to receive tile is sound, firm, dry, clean and free of oily or waxy films and curing compounds.
- B. Verify that grounds, anchors, plugs, hangers, bucks, electrical and mechanical work in or behind tile have been installed prior to proceeding with tile work.

- C. Notify Architect of any conditions detrimental to proper installation of materials. Make corrections to defective or unsatisfactory conditions as required.
- D. Do not proceed with installation until defective or unsatisfactory conditions have been corrected and is acceptable to installer and Architect.

3.2 CRACK-ISOLATION MEMBRANE FOR THIN-SET INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane that is bonded secure to substrate. Install membrane over concrete slab substrates indicated to receive tile as scheduled.
- B. Where bridging control joints in concrete-slab-on-grade floor substrates are required, including at construction and contraction joints, install crack isolation membrane according to manufacturer's joint bridging application guidelines.
 - 1. Install membrane cut to length and width of size equal to at least three times the longest dimension of the tile being installed to cover the control joint.
 - 2. Install membrane with width centered over control joint according to application method for type of membrane being used.
- C. Clean substrates and fill cracks with mortar material as directed by manufacturer's instruction.
- D. Chlorinated-Polyethylene-Sheet Membrane Application:
 - 1. Bond membrane to substrate using recommended thin-set mortar material. Install membrane in widths required embedded to bond coat.
 - 2. Make joints and seams as required by methods as directed by manufacturer's instruction.
 - 3. Remove air pockets using weighted roller as recommended by crack isolation membrane at horizontal areas ensuring complete coverage and full penetration of bond coat into fabric.
- E. Fabric-Reinforced, Modified-Bituminous Sheet Membrane Application:
 - 1. Clean and prepare substrates according to manufacturer's installation instructions to ensure adhesion and optimal bond of membrane.
 - 2. Prime substrate surfaces with membrane manufacturer's recommended primer. Allow primer to dry until tacky to the touch for application of membrane.
 - 3. Precut membrane, with release film still intact, to sizes required for areas to be tiled and install over primed substrate surfaces.
 - 4. Position membrane accurate to locations. Peel back release film from leading edge of membrane and start application adhering sheet to primed substrate. Continue removing release film once membrane is firm in place, unrolling and applying sheets adhered in position smooth to surfaces without wrinkles or bubbles.
 - 5. Butt joint seams tight without overlap, do not lap edges or ends of membrane over each other.
 - 6. Roll with weighted roller as recommended by manufacturer over installed membrane to ensure positive bond to substrate.

- F. Do not install tile over crack isolation membrane until installation has cured. Protect installation from construction traffic until time of tile setting work.

3.3 TILE INSTALLATION

- A. Install tile complying with TCNA installation methods indicated and applicable installation standards of ANSI A108, except where more stringent requirements are specified.
- B. Locate accessories, control joints and expansion joints before installing tile. Coordinate location and alignment with tile joints.
- C. Layout: Center tiles within areas to avoid unequal tile widths at opposite walls and tiles of less than 1/2 tile width.
 - 1. Align tile joints straight, perpendicular and parallel to walls unless otherwise indicated.
 - 2. Align joints in floor tile with joints in base or wall tile.
 - 3. Terminate tile fitted neat at obstructions, edges and corners without disrupting pattern or joint alignment.
- D. Cutting and Fitting: Cut and drill tiles without damaging or marring exposed tile faces. Rub cut edges smooth with carborundum stone.
 - 1. Grind and fit tile at intersections, against trim and at built-in fixtures and accessories.
 - 2. Fit tile around outlets, pipes, fixtures and fittings so that tile edges will be concealed under applied escutcheons, collars or plates.
- E. Grout Joints: Maintain uniform joint widths, straight and aligned throughout installation. Install with joint widths for tile types specified.
- F. Grout Joints: Provide 1/4-inch joint width, unless otherwise indicated. Maintain uniform joint widths, straight and aligned throughout installation.
 - 1. Floor or Paver Tiles (tiles sizes larger than 8-inches): Provide 3/16-inch joint width, unless otherwise indicated.
 - 2. Glazed Wall Tiles: Provide 1/8-inch joint width, unless otherwise indicated.

3.4 CONTROL AND EXPANSION JOINTS

- A. Locate control and expansion joints in accordance with TCNA EJ171. Location of joints shall be approved in advance by Architect.
- B. Construct control and expansion joints extending through tile and setting bed. Leave joint cavities open, free of dirt, debris, grout, mortar and setting materials for installation of compressible materials and sealant. Do not saw cut joints after installation of tiles.
 - 1. Locate floor control joints at spacings indicated but not to exceed 12-ft on center each direction.

2. Provide control joints at perimeter of floor tile areas abutting walls, curbs, columns, dissimilar floor materials and changes of substrates.
3. At vertical internal corners of wall tiles and where tiles abut dissimilar materials provide sealant control joints in lieu of grout joints.
4. Where tile work occurs over control joints or cold joints in structure, provide tile expansion joint located direct over structural joints.
 - a. Install crack isolation membrane to bridge joint to offset location of expansion joints in tile if required.
 - b. Width of tile expansion joint shall be same as structural joint width.
- C. Width of tile control and expansion joints shall match width of grout joints, but not less than 1/4-inch, except for structural joints required to extend through tile shall be of matching width or greater.
- D. Seal joints in accordance with TCNA EJ171. Prime joints and install sealant materials and related accessories in accordance with manufacturer's product data. Tool sealant joint concave.

3.5 EDGE PROTECTION AND TRANSITIONS ACCESSORIES INSTALLATION

- A. Prepare surfaces using methods recommended by the accessories manufacturer for substrates to which products are to be mounted.
- B. Install in accessories to align flush with tile surfaces, unless product design indicates otherwise, according to manufacturer's printed instructions.

3.6 TILE INSTALLATION METHODS

- A. Floor Tiles; Thin-Set Over Concrete Slab-On-Grade, Interior:
 1. Installation Method: TCNA F113-18 and F125-Partial-18 where offset location of control joints are required.
 2. Setting Method: Latex-portland cement mortar. Install crack isolation membrane bonded to substrate as specified where required for offsetting control locations in tile.
 3. Grout Type: Polymer modified cement grout.
- B. Floor Tiles; Thin-Set Over Elevated Concrete Slabs, Interior: (Upper levels above grade supported on framed construction)
 1. Installation Method: TCNA F113A-18 and F125-Full-18.
 2. Setting Method: Latex-portland cement mortar over crack isolation membrane bonded to substrate
- C. Wall Tiles; Thin-Set Over Glass-Mat, Water-Resistant, Gypsum Backing Board, Interior:
 1. Installation Method: TCNA W245-18.
 2. Setting Method: Latex-portland cement mortar.

3. Grout Type: Polymer modified cement grout.
- D. Tile Base; Thin-Set Over Gypsum Board, Interior:
1. Installation Method: TCNA W243-18.
 2. Setting Method: Latex-portland cement mortar.
 3. Grout Type: Polymer modified cement grout.

3.7 CLEANING AND PROTECTION

- A. Keep tile surfaces clean as work progresses. Do not permit setting and grouting materials, residue and other foreign materials to accumulate on tile face. Clean tile upon completion of installation as specified.
- B. Clean installed tile in accordance with tile and grout manufacturer's recommendations using specified cleaners after setting materials have cured.
1. Allow grout installation to cure for minimum fourteen (14) days prior to permitting tile work to be cleaned.
 2. Do not use acid solutions to clean tile.
- C. Protection:
1. Upon completion of tile installation and after cleaning of tile and grout joints, protect tile work throughout remainder of construction by covering with heavy duty kraft paper or hardboard.
 2. Prior to Date of Substantial Completion, remove protective covering for final cleaning.

END OF SECTION 09 30 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

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. Section Includes: Acoustical panels and exposed suspension systems for ceilings.
- B. Extent of each type acoustical ceiling is shown and scheduled on drawings.
- C. Related work specified elsewhere includes:
 - 1. Division 6 Section – "Rough Carpentry." (concealed P.T. wood blocking and grounds)
 - 2. Division 7 Section – "Joint Sealants."
 - 3. Division 9 Section – "Gypsum Board Assemblies."

1.3 PERFORMANCE REQUIREMENTS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
- B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- C. Surface-Burning Characteristics: Complying with ASTM E 1264 for Class A materials and tested per ASTM E 84; testing performed by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less,
 - 2. Smoke-Developed Index: 50 or less.
- D. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's product specifications and installation instructions for each acoustical ceiling material required, and for each suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications.
 - 1. Include manufacturer's seismic installation details.
 - 2. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods, which may be detrimental to finishes and acoustical performance.
- B. Shop Drawings: Show layout of ceiling including locations of light fixtures, grilles, diffusers and sprinkler heads.
 - 1. Indicate hanger spacings, clip anchors or inserts, fastening details, splicing methods for main and cross runners.
 - 2. Include details for ceiling level changes, support methods for light fixture, diffusers, grilles and similar items.
- C. Samples:
 - 1. Set of 6-inch by 4-inch square samples for each acoustical unit required, showing full range of exposed color and texture to be expected in completed work.
 - 2. Set of 12-inch length samples of each exposed runner and molding.
- D. Qualification Data: Submit for qualified installer to demonstrate their capabilities and experience; include documentation indicating compliance with specified qualification requirements. (Submit for Architect's information only.)
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling. (Submit for Architect's information only.)

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm with not less than three (3) years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install a minimum 12-ft by 12-ft. area of each ceiling type specified, in spaces designated by Architect.

2. Notify Architect when spaces are ready for observation and review. Obtain Architect's approval of mockups before starting installation.
 3. Approved mock-up shall serve as a standard of quality for ceiling installations. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

- A. Space Enclosure: Do not install interior acoustical ceiling until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.
- B. Coordination:
 1. Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by or penetrating through, ceilings, including light fixtures, HVAC equipment, food service exhaust hoods, fire-suppression system components (if any), conveyor systems and partition system (if any).
 2. Schedule installation to occur after other work which can generate dust is completed. Schedule acoustical material installation to minimize need for removal and replacement to accommodate work of other trades.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver maintenance materials to Owner.
 1. Acoustical Ceiling Units: Furnish quantity of full size units equal to two percent (2.0%) of amount installed.

2. Exposed Suspension Components: Furnish quantity of each exposed component required for actual installation equal to two percent (2.0%) of amount installed.

PART 2 - PRODUCTS

1.9 ACOUSTICAL CEILING PANELS

- A. Basis of Design: Product as scheduled on drawings.
 1. Acoustical ceiling panels of similar design, material, construction and of matching color, pattern and texture by other acceptable manufacturers may be submitted for Architect's acceptance.
 2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of manufacturer's product data, test reports and samples.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
- C. Panel Type: ASTM E 1264, Type IV, Form 2, Pattern E; water-felted mineral fiber, membrane-faced overlay panels with painted finish.
 1. Size: 24 by 24 inches (2-ft. by 2-ft.), unless otherwise indicated on Drawings.
 2. Thickness: 7/8-inch.
 3. Edges: Rabbeted and beveled (Beveled Tegular).
 4. Noise Reduction Coefficient (NRC): 0.80, minimum.
 5. Ceiling Attenuation Class (CAC): 35, minimum.
 6. Light Reflectance: 0.86.
 7. Surface Finish: Factory-applied latex paint finish, white color.
- D. Suspension System: Grid profile size as indicated on Drawings for scheduled ceiling panel. Provide grid module matching ceiling panel size.

1.10 METAL SUSPENSION SYSTEMS

- A. Acceptable Manufacturers; subject to compliance with specified requirements:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corporation.
 3. USG Interiors, Inc.
- B. Narrow Profile Exposed Grid System: Narrow-face, capped, double-web, galvanized steel suspension system.
 1. Structural Classification: Intermediate duty system in accord with ASTM C635.
 2. Main and Cross Runners: Roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to

- ASTM A 653/A 653M, not less than G30 coating designation; with prefinished metal caps on flanges.
 - 3. End Condition of Cross Runners: Override (stepped) type.
 - 4. Face Design: Flat, flush.
 - 5. Cap Material: Galvanized cold-rolled steel.
 - 6. Cap Face Size: 9/16-inch width.
 - 7. Cap Finish: Factory-applied low-gloss paint finish; white color.
- C. Standard Exposed Grid System: Wide-face, capped, double-web, galvanized steel suspension system.
- 1. Structural Classification: Intermediate duty system in accord with ASTM C635.
 - 2. Main and Cross Runners: Roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than **G30** coating designation; with prefinished metal caps on flanges.
 - 3. End Condition of Cross Runners: Override (stepped) type.
 - 4. Face Design: Flat, flush.
 - 5. Cap Material: Galvanized cold-rolled steel.
 - 6. Cap Face Size: 15/16-inch width.
 - 7. Cap Finish: Factory-applied low-gloss paint finish; white color.
- D. Finishes and Colors: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1.11 SUSPENSION SYSTEM ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Cast-in-place or Postinstalled expansion anchors.
 - b. Corrosion Protection: Either type as specified.
 - 1) Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - 2) Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or

other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

- B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 12-gauge (0.106-inch) diameter wire.
- C. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint; sized to support design loads.
- D. Angle Hangers: Angles with legs not less than 7/8-inch wide; formed with 0.04-inch thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch diameter bolts.
- E. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24-inches on center on all cross tees.
- F. Edge Moldings and Trim: Roll-formed, sheet-metal type in profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

1.12 MISCELLANEOUS MATERIALS

- A. Fasteners: Cadmium plated, type recommended by suspension system manufacturer, but for not less than 1/2-inch penetration of substrate.
- B. Acoustical Sealants:
1. Acceptable Products: Subject to compliance with requirements, provide one of the following:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. Pecora Corporation; AIS-919.

- c. Specified Technologies, Inc.; SpecSeal Smoke N' Sound Acoustical Caulk.
 - d. Tremco, Inc.; Acoustical Sealant.
 - e. USG Corporation; Sheetrock Acoustical Sealant.
2. Characteristics: Manufacturer's non-hardening, non-bleeding, nonstaining, gunnable, synthetic rubber or acrylic latex compound complying with ASTM C834.
- a. Acoustical Performance: Effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - b. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

1.13 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

1.14 PREPARATION

- A. Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings. Furnish concrete inserts, hanger clips and similar devices to other trades for installation well in advance of time needed for coordination of other work.
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
- C. Where suspended acoustical ceilings are indicated to be hung below drywall sub-ceilings, install sub-ceiling hanger clips at locations for hanger wire attachment. Attach clips screw fastened through gypsum board into support framing spaced at grid locations required for securing suspension system hangers wires.

1.15 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636 and design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48-inches on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8-inches from ends of each member.
 - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16-inches on center and not more than 3-inches from ends, leveling with ceiling suspension system to a tolerance of 1/8-inch in 12-feet. Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange acoustical units and orient directionally patterned units, (if any) in a manner shown by reflected ceiling plans.
 2. Install panels with pattern running in one direction, as indicated, or if not indicated, as directed by Architect.
 3. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 4. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and in spaces as recommended by panel manufacturer's written instructions, unless otherwise indicated.

1.16 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract including General and Supplementary conditions and Division 1 Specifications sections, apply to work of this section.

1.2 SUMMARY

- A. Section Includes:

- 1. Modular carpet tile.
 - 2. Sheet carpeting.

- B. Related Sections:

- 1. Division 3 Section – "Cast-In-Place Concrete."
 - 2. Division 9 Section – "Resilient Flooring."
 - 3. Division 9 Section - "Moisture Mitigation Floor Sealer."

1.3 PERFORMANCE REQUIREMENTS

- A. Carpet shall meet the following criteria with tests having been performed by a nationally recognized independent Testing Laboratory. Identify carpet with appropriate markings of applicable testing and inspecting agency.
 - 1. Flooring Radiant Panel Test: Class I, minimum 0.45 watts per square centimeter, when tested in accordance with ASTM E648.
 - 2. Smoke Development: Less than 450 specific optical density when tested in accordance with NFPA 258.
 - 3. Flammability: Passing methenamine pill test in accordance with ASTM D2859 or CPSC 16 CFR, Part 1630.
 - 4. Electrostatic Propensity: Less than 3000 volts when tested in accordance with AATCC 134.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product literature and installation instructions for each type carpeting, adhesives and accessories.
 - 1. Indicate primers, adhesives and seaming methods proposed for installation.
 - 2. If carpeting manufacturer does not publish detailed installation data, installer shall submit written detailed installation procedures proposed for Architect's approval.

- B. Shop Drawings: Submit drawings indicating layout of each type carpeting showing patterns, pile direction, joint locations and accessories
1. Indicate type carpet in each area and installation method.
 2. Indicate carpet type, color, and dye lot.
 3. Show locations of columns, doorways, enclosing walls or partitions and built-in cabinets.
 4. Indicate locations where cutouts are required in carpet.
 5. Include transition details to other flooring materials.
- C. Samples:
1. Carpet Tile: Submit full size carpet tile sample, of each type required for Project in selected colors and patterns. Label sample with manufacturer's name, material description, color and pattern.
 2. Sheet Carpeting: Submit two samples, minimum 12-inches by 18-inches (1'-0" by 1'-6") size, of each type carpet in selected colors and patterns.
 3. Accessories: Submit 1-ft. (12-inch) length samples of carpet termination edging.
- D. Qualification Data: Submit for installer to demonstrate their training, experience and capabilities; include documentation indicating compliance with specified qualification requirements. (Submit for Architect's information only.)
- E. Test Reports: Submit test reports from an independent Testing Laboratory indicating that carpet comply with specified performance requirements. Submit for Architect's information only.
- F. Maintenance Data: Submit manufacturer's recommended care and cleaning instructions for carpet materials. Indicate recommendations for frequency of cleaning. Submit as part of Contract Close-out documents.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall be certified by the Floor Covering Installation Board (FCIB) or one who can demonstrate compliance with FCIB certification program requirements.
- B. Manufacturer's Field Service: Obtain the services of carpet tile manufacturer's field representative to observe start of carpet installation to verify and assure proper use and application of materials.
- C. Mockups: Construct mockups prior to laying carpet tile to verify selections and to demonstrate aesthetic effects and set quality standards for materials and installation.
1. Install minimum 8-ft by 8-ft area of carpet tiles at location as directed by Architect indicating the following:
 - a. Patterns and colors.
 - b. Seams and edge treatment.
 - c. Workmanship to be expected in completed installation.
 2. Notify Architect when mock-ups are ready for observation and review. Obtain

3. Architect's acceptance of mockups before starting installation.
Accepted mockup may become part of the completed Work if undamaged at time of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver sheet carpet materials in manufacturer's original mill wrappings with register tag number attached and labels intact. Schedule delivery only after building spaces are conditioned under controlled temperatures and relative humidity.
- B. Inspect materials upon delivery to project site for damages and defects; verify colors and patterns. Damaged or defective materials, including incorrect colors or patterns shall not be accepted. Remove rejected materials from site and replace.
- C. Store materials in conditioned spaces, off floor and under cover in a dry, well-ventilated area. Protect from damage, staining, soiling and moisture. Do not stand rolled materials on ends.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Maintain temperatures above 65 degrees F. and relative humidity to approximate normal conditions for occupancy in spaces to receive carpet for minimum 48 hours prior to starting installation.
 2. Remove carpet from mill wrappings and allow to acclimate in conditioned spaces at least 24 hours prior to installation.
- B. Scheduling and Sequencing: Install carpet materials after ceiling and wall finish work, including painting, are completed. Schedule installation to minimize access and traffic to finished spaces following completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials for Owner's maintenance use.
 1. Carpet tile: Provide products matching those installed; packaged in manufacturer's protective covering for storage and identified with labels describing contents.
 - a. Furnish full-size carpet tile units equal to five-percent (5%) of amount installed for each type indicated, but not less than 10 sq. yd.
 - b. Deliver extra materials to Project site before installation begins.
 2. Sheet Carpeting: Salvage scraps, minimum 1-ft. (12-inches) in width and over three sq. ft. in area, from installation for Owner's use.
- B. Store materials at locations as directed by Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers; subject to compliance with specified requirements:

1. Bentley Mills, Inc.
2. Interface, LLC.
3. J & J Commercial / Div. J& J Industries, Inc.
4. Lees Carpet / Div. Mohawk Industries, Inc.
5. Patcraft Commercial Carpet.
6. Shaw Contract Group / Shaw Industries, Inc.

2.2 CARPET TILE

A. Basis of Design: As scheduled on drawings.

1. Carpet tile of similar design, material and construction by other acceptable manufacturers may be submitted for Architect's acceptance.
2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of manufacturer's product data, test reports and samples.

B. Carpet Tile Color, Pattern, and Texture: As indicated on drawings.

2.3 SHEET CARPET

A. Basis of Design: As scheduled on drawings.

1. Products of similar design and construction by other acceptable manufacturers may be submitted for Architect's acceptance.
2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of specified product data and samples.

B. Carpet Color, Pattern, and Texture: As indicated on drawings.

2.4 INSTALLATION ACCESSORIES

A. Adhesives:

1. Types:
 - a. Carpet Tile: Type: Water-resistant, mildew-resistant, non-staining, low VOC, pressure-sensitive type as recommended by carpet tile manufacturer for substrate conditions encountered and complies with flammability requirements for installed carpet tile. Adhesive shall be release type which will allow removal of carpet tile without damage to material or substrate.
 - b. Sheet Carpeting: Waterproof mildew-resistant, non-staining, low VOC type as

recommended by carpet manufacturer for substrate conditions encountered. Adhesive shall be release type which will allow removal of carpet without damage to material or substrate.

2. VOC Content: Not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

B. Carpet Termination Edging:

1. Acceptable Products:

- a. Burke Mercer Flooring Products / Div. Burke Industries, Inc.; Imperial Reducer.
- b. Johnsonite / Tarkett Company; Edge Guard.
- c. Roppe Corporation; Vinyl Glue Down Reducer.

2. Characteristics:

- a. Type: Vinyl tapered carpet edge molding; undercut sized to fit carpet thickness.
- b. Color: As selected by Architect from manufacturer's standard colors.

3. Adhesive: Type recommended by manufacturer for installation.

C. Rubber Wall Base: As specified in Division 9 Section – "Resilient Flooring."

D. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer

E. Concrete-Slab Primer: Nonstaining type as recommended carpet manufacturer.

F. Miscellaneous Installation Accessories: Provide seaming cement, thread and similar accessories required for complete installation of carpet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive carpet installation. Verify that conditions are acceptable for carpet installation.
- B. Notify Architect in writing of any defective or unsatisfactory conditions which would affect the proper installation of materials.
- C. Do not proceed with installation until defects or unsatisfactory conditions have been corrected and is acceptable to installer.
- D. Installation of carpet materials to substrates by installer shall confirm acceptance that conditions are satisfactory.

3.2 PREPARATION

- A. Substrates for carpet installation shall be clean and dry with level surfaces; free of irregularities and depressions.
- B. Where required, fill depressions with leveling compound, including demolished areas where existing flooring materials were removed leaving irregularities in slab surfaces, grind ridges and high spots to provide smooth level surface for carpet installation and to allow for proper alignment with adjacent flooring material. Mix and apply leveling compound to clean prepared surfaces in accordance with manufacturer's instruction.
- C. Perform moisture and adhesion tests in accordance with carpet manufacturer's recommendations on concrete subfloors to determine if substrates are dry within acceptable limits for installation of materials, and to detect presence of curing compounds and conditions affecting adhesion.
 - 1. Perform anhydrous calcium chloride test in accordance with ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. in 24 hours.
 - 2. Perform relative humidity test using in situ probes in accordance with ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
 - 3. Perform alkalinity and adhesion tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- D. Prior to start of carpet installation, vacuum and clean substrates free of oil, grease, paint, dirt, debris and other foreign materials.

3.3 WORKMANSHIP

- A. Install carpeting materials in accordance with manufacturer's product data and CRI Carpet Installation Standard 2011, except where more stringent requirements are specified herein.
- B. Lay carpet with seams and accessories at locations in accordance with final reviewed and accepted shop drawings.
- C. Install carpet with pattern, texture and grain running in the same direction, unless otherwise indicated. Patterned and bordered carpet shall be laid without distortion or waviness, straight and aligned.
- D. Extend carpet into closets of rooms indicated to receive carpeting unless other floor finish is scheduled for installation as indicated on drawings. Carpet shall be installed under movable furniture and equipment located in carpet areas.
- E. Provide cutouts in carpet for floor electrical and telephone outlets. Cut carpet materials to fit tight against outlets so that floor substrate is not visible. Seal edges of carpet to prevent from unraveling or pulling up of material.
- F. Install carpet termination edging at carpet edge locations exposed to traffic except where thresholds or other similar devices are indicated.

- G. Carpet edges and seams shall be straight and square with adjacent surfaces in the finished installation.

3.4 CARPET TILE INSTALLATION

- A. Install carpet tile materials in accordance with manufacturer's product data and CRI Carpet Installation Standard 2011, except where more stringent requirements are specified herein.
- B. Apply adhesive in accordance with carpet tile manufacturer's printed instructions. Apply to half of width at a time, beginning at seam, with carpet width already laid. Adhere each carpet tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Install pattern parallel to walls and borders.
- E. Cut and fit carpet tile to butt tight to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install carpet termination edging at carpet edge locations exposed to traffic except where thresholds or other similar devices are indicated.
- I. Carpet edges and seams shall be straight and square with adjacent surfaces in the finished installation.

3.5 SHEET CARPET DIRECT GLUE-DOWN INSTALLATION

- A. Unroll and relax carpet prior to installation. Cut and fit to size for spaces before application of adhesive. When cutting materials, allow 1/2-inch overlap with adjacent widths.
- B. Lay out carpet with minimum number of seams using maximum size material practicable
 - 1. Locate seams in doorways to occur parallel to and align directly under door locations.
 - 2. Seams perpendicular to door openings shall be located so as not to occur at doorways.
 - 3. Do not seam weft to warp.
- C. Apply adhesive in accordance with manufacturer's printed instructions. Apply to half of width at a time, beginning at seam, with carpet width already laid.
- D. Apply seaming cement to cut backing, cutouts and pile edges without evidence on carpet faces. Align edges and compress 1/2-inch overlap at seam by fitting against width already laid; then

push looseness away from seam.

- E. Roll out air bubbles using a roller weighing minimum 35-lbs. but not more than 75-lbs., as installation progresses.
- F. Where transverse seams are required, loosely back-sew lengths together.
- G. Where carpet is installed against vertical surfaces, trim straight and true to line, within 1/32-inch of abutting surfaces.

3.6 CLEANING AND PROTECTION

- A. Clean adhesive smears immediately from carpet surfaces with solvent or cleaner as recommended by manufacturer.
- B. Upon completion of installation, remove rubbish, debris and selvages. Sort out carpet scraps to be saved.
- C. Vacuum clean carpet surfaces using a commercial vacuum cleaner having a rotating agitator. Utilize crevice tool attachment for vacuuming corners and crevices.
- D. Clean soils and remove stains with cleaning compounds acceptable to carpet manufacturer.
- E. Protect installed carpeting against damage from construction operations and placement of equipment and fixtures during the remainder of construction period.
 - 1. Cover carpeted areas after cleaning with non-staining heavy kraft paper.
 - 2. Protect installation from rolling traffic by using hardboard or plywood sheets in affected areas.
 - 3. Maintain protective covering in-place and limit traffic over carpeted areas until time of Substantial Completion.
- F. Just prior to Date of Substantial Completion, remove protective covering and vacuum carpet clean. Steam clean carpet if necessary to remove soils and stains.
- G. Damaged or stained carpeting which cannot be cleaned shall be replaced.

END OF SECTION 09 68 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

- A. This Section includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces, except where noted otherwise.
 - 1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
 - 2. Painting includes field painting exposed steel and iron work, and primed metal surfaces.
- B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
- C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
 - 1. Examples of prefinished items not to be painted include, in part, the following factory-finished components:
 - a. Architectural woodwork.
 - b. Plastic laminate casework.
 - c. Flush wood doors.
 - d. Acoustical materials.
 - e. Toilet compartments and urinal screens.
 - f. Elevator entrance doors and frames.
 - g. Elevator equipment
 - h. Finished mechanical and electrical equipment.
 - i. Light fixtures.
 - j. Distribution cabinets.
 - k. Finish Hardware.
 - 2. Examples of concealed surfaces not to be painted include, in part, wall or ceiling surfaces in the following generally inaccessible areas:
 - a. Foundation spaces.

- b. Furred areas.
 - c. Ceiling plenums.
 - d. Utility tunnels.
 - e. Pipe spaces or chases.
 - f. Duct shafts.
 - g. Elevator shafts.
3. Examples of Finished metal surfaces not to be painted include, in part, the following:
- a. Anodized aluminum.
 - b. Fluoropolymer finished aluminum or steel.
 - c. Stainless steel.
 - d. Chromium plate.
 - e. Copper.
 - f. Bronze.
 - g. Brass.
4. Examples of operating parts not to be painted include, in part, moving parts of operating equipment such as the following:
- a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's most current technical information, label analysis, and application instructions for each material proposed for use.
- 1. List each material and cross-reference to scheduled paint types, and including each specific coating, finish system, and application.
 - 2. Identify each material by the manufacturer's catalog number and general classification.
- B. Samples:
- 1. For Initial Selection: For each type of finish-coat material indicated, submit manufacturer's color chips for surfaces to be coated.
 - 2. For Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
 - a. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

- b. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
- c. Submit painted samples on the following substrates for Architect's review of color and texture only.
 - 1) Gypsum Board: 6-by-10-inch samples on gypsum board, of each type finish and representative color. Apply primer, other base coats and final coats.
 - 2) Concrete Unit Masonry: 4-by-8-inch samples of masonry, with mortar joint in the center, for each finish and color.
 - 3) Painted Wood: 8-inch square samples for each color and material on hardboard.
 - 4) Stained or Natural Wood: 4-by-8-inch samples of natural or stained finish on representative wood surfaces of species specified.
 - 5) Ferrous Metal: 3-inch square samples for each color and finish applied on flat metal.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.
 - 1. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 2. Notify the Architect of any problems anticipated using the materials specified, prior to proceeding with work.
- C. Material Quality: Provide the manufacturer's best quality grade paint material of the various coating types specified.
 - 1. Paint material containers not displaying manufacturer's product identification will not be acceptable.
 - 2. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude approved equivalent products of other manufacturers.
- D. Color Pigments: Pure, non-fading, applicable types to suite substrates and service indicated.
- E. Lead content in pigments or other painting materials and components is not allowed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's name, stock number, and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45-deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.
 2. Take necessary measures to ensure that workers, others present or passing through or inspecting work areas (painting or any other work), and the work areas themselves are protected from fire and health hazards resulting from handling, mixing, and application of materials.

1.6 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50-deg F and 90-deg F, unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45-deg F and 95-deg F, unless otherwise permitted by paint manufacturer's printed instructions.
- C. Do not apply paint in snow, rain, fog, or mist, or when the relative humidity exceeds 85-percent, or at temperatures less than 5-degrees F above the dew point, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
1. Apply no materials in spaces where dust is being generated.
 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer, during application, drying and curing periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with specified requirements, provide products of one of the following:
1. Benjamin Moore and Company.
 2. PPG Industries, Inc. (PPG Paints).

3. The Sherwin-Williams Company.

2.2 PAINT MATERIALS

A. Standard of Quality:

1. Except as otherwise noted, products specified as a standard of quality are manufactured by PPG Paints. Products of other specified acceptable manufacturers listed, similar in type and quality, are acceptable for use, subject to approval of product list submitted for review.
2. Where products other than those of the manufacturer listed as the standard of quality are specified in Painting Schedule, such products have been selected to achieve specific results and substitutions will be allowed only in accordance with Conditions of the Contract.

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Paint thinners and tints shall be products of same manufacturer as paints or approved by manufacturer for use with their products. Use thinners only within the recommended limits if required.
3. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Color Pigments: Pure, non-fading, applicable types to suite substrates and service indicated.

D. Hazardous Materials Prohibition: Lead content in pigments or other painting materials and components is not allowed.

E. Colors: As selected by Architect from manufacturer's full range, unless otherwise indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint.
 1. Do not begin paint application until unsatisfactory conditions have been corrected.
 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

- A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning.
 2. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and re-prime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
 2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
 3. Concrete Floor Surfaces to be Sealed or Painted:
 - a. Surface shall be free of curing compounds and contaminants.
 - b. Clean concrete surfaces with a 5-percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before applying coating materials.
 - c. If required, abrasive blast clean concrete surfaces as recommended by paint manufacturer, removing laitance and foreign matter, to produce open face texture finish similar to 100 grit fine sandpaper. Repeat procedure if sandpaper texture finish is not achieved. Surface preparation shall be acceptable to paint manufacturer.
 - d. Remove debris and vacuum surfaces clean before application of coating materials.
 4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer. After priming,

- fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- b. Prime, stain, or seal unfinished wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - c. When transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.
5. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.
- a. Treat bare, sandblasted, or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
6. Galvanized Surfaces: Clean galvanized surfaces with non- petroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- C. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.
1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
 3. Use only thinners approved by the paint manufacturer, and only within recommended limits.
- D. Tinting: Tint each primer and undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied.
1. Tint undercoats to match the color of the finish coat(s), but provide sufficient differences in shade of undercoats to distinguish each separate coat.
 2. Finish coats as scheduled, shall be same color for each coat required.

3.3 APPLICATION

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 2. Paint surface treatments and finishes are indicated on the Drawings and in Specifications.
 3. Finish colors will be selected after Bidding, unless indicated otherwise.
 4. Provide finish coats that are compatible with primers used.
 5. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
 6. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
 7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, connector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
 8. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
 9. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 10. Finish doors on tops, bottoms, and side edges same as faces.
 11. Sand lightly between each succeeding enamel or varnish coat.
- B. Fire-Rated and Smoke-Rated Walls: Where fire-rated and smoke-rated walls run above suspended ceilings, paint by stenciling "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" on wall surfaces to provide permanent identification according to building code requirements.
1. Make height of characters 3-inches and stroke width not less than 3/8-inch.
 2. Space stenciling at 20-ft. (20'-0") on center but not less than one stenciling on each wall.
- C. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- D. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Tanks that do not have factory-applied final finishes.
 4. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 5. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

- E. Electrical items to be painted include, but are not limited to, the following:
1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- F. Primers:
1. Omit primer on metal surfaces that have been shop-primed and touch-up painted, only after verifying full compatibility of shop primers with materials specified for the next coat and finish coats.
 2. Primer may be omitted at previously painted existing surfaces in good condition, except at interior concrete, plaster and drywall surfaces, after repairs to any existing damaged substrates and after spot priming of existing damaged paint finish, followed by cleaning and preparation recommended in writing by paint manufacturer.
- G. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coats to permit proper drying.
 2. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- H. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- I. Block Fillers: Apply block fillers to new or previously unpainted concrete masonry block at a rate to ensure complete coverage with pores filled.
- J. Prime Coats: Before application of finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.
- K. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- L. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster.
1. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
 2. Provide satin finish for final coats.

- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.4 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
- B. Provide “wet paint” signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINT SCHEDULE

- A. The quantities of coats specified are minimums. Contractor is responsible for application of any additional coats necessary to achieve required coverage and color uniformity.

- B. Ferrous Metal Surfaces: PPG Paints (Full-Gloss Acrylic Enamel)

Primer (one coat):	PPG 6-208 Speedhide Interior/Exterior Rust Inhibitive Metal Primer.
Finish (two coats):	PPG 90-374 Series Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamels.

- C. Galvanized Steel Surfaces: PPG Paints (Full-Gloss Acrylic Enamel)

Primer (one coat):	PPG 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
Finish (two coats):	PPG 90-374 Series Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamels.

- D. Aluminum Surfaces: PPG Paints (Full-Gloss Acrylic Enamel)

Primer (one coat):	PPG 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
Finish (two coats):	PPG 90-374 Series Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamels.

E. Concrete Surfaces: PPG Paints (Semi-Gloss Acrylic Enamel)

Primer (one coat): PPG 4-603XI Perma Crete Interior/Exterior Acrylic Latex Alkali Resistant Primer.
 Finish (two coats): PPG 6-900XI Series SpeedHide Exterior 100% Acrylic Latex Semi-Gloss.

F. Fiber-Cement Panel Surfaces: PPG Paints (Satin Acrylic Enamel)

Primer (one coat): PPG 4-603XI Perma Crete Interior/Exterior Acrylic Latex Alkali Resistant Primer.
 Finish (two coats): PPG 6-2045XI SpeedHide Exterior 100% Acrylic Latex Satin.

G. Molded Polyurethane Millwork: PPG Paints (Satin Acrylic Enamel)

Primer (one coat): Manufacturer's factory applied primer.
 Finish (two coats): PPG 6-2045XI SpeedHide Exterior 100% Acrylic Latex Satin.

H. Wood Surfaces; Painted Finish: PPG Paints (Full-Gloss Acrylic Enamel)

Primer (one coat): PPG 17-921XI Seal Grip Interior Exterior Universal Acrylic Primer
 Finish (two coats): PPG 6-8534 Series SpeedHide Interior/Exterior 100% Acrylic Gloss

I. Wood Surfaces; Solid Stain Finish: PPG Paints (Acrylic Stain)

Finish (two coats): PPG FLD820 Flood Pro Series Solid Color 100% Acrylic Stain

3.7 INTERIOR PAINT SCHEDULE

A. The quantities of coats specified are minimums. Contractor is responsible for application of any additional coats necessary to achieve required coverage and color uniformity.

B. Ferrous Metal Surfaces: PPG Paints (Semi-Gloss Acrylic Enamel)

Primer (one coat): PPG 6-208 Speedhide Interior/Exterior Rust Inhibitive Metal Primer..
 Finish (two coats): PPG 6-4510XI Series SpeedHide Zero Interior Zero VOC Semi-Gloss Latex.

C. Galvanized Steel Surfaces: PPG Paints (Semi-Gloss Acrylic Enamel)

Primer (one coat): PPG 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel.
 Finish (two coats): PPG 6-4510XI Series SpeedHide Zero Interior Zero VOC Semi-Gloss Latex.

D. Painted Structural Steel Surfaces: PPG Paints (Semi-Gloss Acrylic Enamel)

Primer (one coat): Shop applied primer.
Finish (two coats): PPG 6-4510XI Series SpeedHide Zero Interior Zero VOC
Semi-Gloss Latex.

E. Gypsum Board Surfaces: PPG Paints (Flat Acrylic Paint)

Primer (one coat): PPG 6-4900XI SpeedHide Zero Interior Zero VOC Latex
Sealer.
Finish (two coats): PPG 6-4110XI Series SpeedHide Zero Interior Zero VOC
Latex Flat.

F. Gypsum Board Surfaces: : PPG Paints (Eggshell Latex Acrylic Enamel)

Primer (one coat): PPG 6-4900XI SpeedHide Zero Interior Zero VOC Latex
Sealer.
Finish (two coats): PPG 6-4310XI Series SpeedHide Zero Interior Zero VOC
Latex Eggshell.

G. Concrete Masonry Unit (CMU) Surfaces [Shower Areas]: PPG Paints (Gloss - Polyamide Epoxy)

Block Filler (one coat): Amerlock 400BF Epoxy Masonry Block Filler.
Finish (two coats): PPG HPC High Gloss Epoxy 95-501 Series.
All block pores shall be completely filled.

H. Concrete Masonry Unit (CMU) Surfaces [Men's and Women's Toilet Rooms]: PPG Paints (Semi-Gloss Acrylic Epoxy)

Block Filler (one coat): PPG 6-15XI Speedhide Interior/Exterior Hi Fill Latex Masonry
Block Filler.
Finish (two coats): PPG 16-551 Series Pitt-Glaze WB Water-Borne Acrylic Epoxy.
All block pores shall be completely filled.

I. Concrete Masonry Unit (CMU) Surfaces (Excluding Toilet Rooms and Shower Areas): Sherwin-Williams (Semi-Gloss Acrylic Enamel).

Block Filler (one coat): PPG 6-7 SpeedHide Interior/Exterior Masonry Latex Block
Filler.
Finish (two coats): PPG 16-551 Series Pitt-Glaze WB Water-Borne Acrylic
Epoxy.

J. Wood Surfaces; Painted Finish: PPG Paints (Semi-Gloss Acrylic Enamel)

Primer (one coat): PPG 17-921XI Seal Grip Interior Exterior Universal Acrylic
Primer
Finish (two coats): PPG 6-4510XI Series SpeedHide Zero Interior Zero VOC
Semi-Gloss Latex.

K. Wood Surfaces; Solid Stain Finish: PPG Paints (Acrylic Stain)

Finish (two coats): PPG FLD820 Flood Pro Series Solid Color 100% Acrylic Stain

L. Wood Surfaces; Semi-Transparent Stain Finish: PPG Paints (Acrylic/Oil Stain)

Finish (two coats): PPG FLD812 Flood Pro Series Semi-Transparent Acrylic/Oil Stain

M. Concrete Floor Sealer: PPG Paints (Waterbased Semigloss, Polyamine Epoxy)

Substrate Preparation: Blast cleaned prepared concrete surface.

Finish (two coats): PPG 98-57 Series Aquapon WB Interior Floor Coating.

3.8 INTERIOR STAINED WOODWORK SCHEDULE

A. Stained Woodwork; Transparent Finish: PPG Paints (Oil Stain and Clear Satin Polyurethane)

Filler Coat	Open-Grain Wood Filler.
Stain Coat:	PPG - DEFT Interior Oil-Based Wood Stain DFT400
Sealer Coat:	PPG – DEFT Interior Oil Based Sanding Sealer DFT60
Finish	PPG - DEFT Interior Oil Based Polyurethane DFT129 Satin.

END OF SECTION 09 91 00

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: High-performance coatings and special preparation of surfaces.

1. Use high performance coating systems specified in this section to finish wastewater treatment plant components, unless otherwise indicated. Without restricting volume or generality, work to be performed under this section may include, but is not limited to:
 - a. Exterior steel
 - b. Interior steel
 - c. Exterior concrete
 - d. Interior concrete
 - e. Piping, hangers, and supports
 - f. Exposed bare pipes (including color coding)
2. Painting or finishing is not needed for following:
 - a. Surfaces or materials specifically scheduled or shown on Drawings to remain unfinished
 - b. Items provided with factory finish.
 - c. Equipment nameplates, fire rating labels, and operating parts of equipment
3. Materials and products having factory-applied primer shall not be considered factory finished.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials:

1. ASTM D16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products

B. SSPC: The Society for Protective Coatings:

1. SSPC - Painting Manual, Volume 2: Systems and Specifications.
2. SSPC-Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red).
3. SSPC-SP 2 - Hand Tool Cleaning.
4. SSPC-SP 3 - Power Tool Cleaning.
5. SSPC-SP 5 - White Metal Blast Cleaning.
6. SSPC-SP 6 - Commercial Blast Cleaning.
7. SSPC-SP 7 - Brush-Off Blast Cleaning.
8. SSPC-SP 10 - Near-White Metal Blast Cleaning.
9. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.

C. National Association of Pipe Fabricators

1. NAPF 500-03-01 Solvent Cleaning
2. NAPF 500-03-02 Hand Tool Cleaning
3. NAPF 500-03-03 Power Tool Cleaning
4. NAPF 500-03-04 Abrasive Blast Cleaning of Ductile Iron Pipe
5. NAPF 500-03-05 Abrasive Blast Cleaning of Cast Ductile Iron Fittings

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit manufacturer information indicating coating materials, manufacturer's name, product name, product number, performance ratings, curing times, mixing, thinning and application requirements.
 - a. Provide material analysis, including vehicle type and percentage by weight and by volume of vehicle, resin and pigment.
 - b. Submit manufacturer's Material Safety Data Sheets (MSDS) and other safety requirements.
- C. Samples: Submit one color chart/color samples, illustrating colors for selection.
- D. Schedule: Contractor shall submit a schedule of items that will receive high-performance coatings per Specification 09 96 00.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer Instructions: Submit special procedures, perimeter conditions requiring special attention.
- G. Quality Assurance Submittals:
 1. Certificates:
 - a. Coatings manufacturer shall certify that coating materials utilized are "non-lead" (less than 0.06% lead by weight in dried film) as defined in Part 1303 of Consumer Product Safety Act.
 - b. Provide certification that specialized equipment as may be required by manufacturer for proper application of coating materials shall be utilized for work of this Section.
 - c. Provide manufacturer's certification that products to be used comply with specified requirements and are suitable for intended application.
 2. Manufacturer's Instructions:
 - a. Submit manufacturer's installation procedures which shall be basis for accepting or rejecting actual installation procedures.
- H. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings, repair and patching techniques.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
 1. Furnish 5 gal of each color of each type of coating specified, for Owner's maintenance use.
 2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.6 QUALITY ASSURANCE

- A. Conform to applicable codes and ordinances for flame, fuel, smoke, and volatile organic compound (VOC) ratings requirements for finishes at time of application.

1.7 QUALIFICATIONS

- A. Provide products from a company specializing in manufacture of high-performance coatings with a minimum of 10 years' experience.
- B. Applicator shall be trained in application techniques and procedures of coating materials and shall demonstrate a minimum of 2 years successful experience in such application.
 1. Maintain, throughout duration of application, a crew of painters who are fully qualified to satisfy specified qualifications.
- C. Single Source Responsibility:
 1. Materials shall be products of a single manufacturer or items standard with manufacturer of specified coating materials.
 2. Provide secondary materials which are produced or are specifically recommended by coating system manufacturer to ensure compatibility of system.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Container Labeling: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Inspection:
 - 1. Accept materials on Site in manufacturer's sealed and labeled containers.
 - 2. Inspect for damage and to verify acceptability.
- D. Store materials in ventilated area and otherwise according to manufacturer instructions.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum Conditions: Do not install materials when temperature is below 35°F or above 110°F.
- C. Refer to specific product information sheets for minimum surface temperature requirements. Surface temperatures shall be at least 5°F (15°C) above dew point and in a rising mode.
- D. Subsequent Conditions: Maintain above temperature range, 24 hours before, during, and 72 hours after installation of coating.
- E. Relative humidity shall be no higher than 85%.
- F. For exterior spray application, wind velocity shall be less than 15 mph (25 kph).
- G. Atmosphere shall be relatively free of airborne dust.
- H. Restrict traffic from area where coating is being applied or is curing.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Include coverage for bond to substrate, and degradation of chemical resistance.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS

A. Manufacturers:

1. Tnemec Company, Inc.
2. Sherwin Williams Company
3. Carboline
4. Or Approved Equal.

2.2 COMPONENTS

A. Coatings:

1. Description:
 - a. Complete multicoat systems formulated and recommended by manufacturer for intended applications and in indicated thicknesses.
 - b. Specified number of coats does not include primer or filler coat.
2. Lead content: None.
3. Chromium Content as Zinc Chromate or Strontium Chromate: None.
4. Maximum VOC Content: As required by applicable regulations.
5. Colors: As selected from manufacturer's standard colors.

B. Epoxy Coating:

1. Modified Polyamine Epoxy
 - a. Usage: A thick film, 100% solids, abrasion-resistant lining designed for wastewater immersion and fume environments. Provides low permeation to H₂S gas, protects against MIC and provides chemical resistance to severe wastewater environments.
 - b. Exposure: Severe.
 - c. Number of Coats: See schedule.
 - d. Finish: Gloss.
 - e. Minimum Solids Content: 100% (mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Perma-Glaze, Series 435, as manufactured by Tnemec, or DuraPlate 5900, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
2. Modified Polyamine Epoxy Mortar
 - a. Usage: A 100% solids, hybrid epoxy mortar designed for severe wastewater immersion and fume environments. Specifically formulated to withstand high levels of hydrogen sulfide gas (H₂S), sulfuric acid (H₂SO₄), as well as other gases

- common to sewer exposures. Aggregate reinforcement provides additional resistance to abrasions and impacts.
- b. Exposure: Severe.
 - c. Number of Coats: See schedule.
 - d. Finish: Gloss.
 - e. Minimum Solids Content: 100% (mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Perma-Shield H2S, Series 434, as manufactured by Tnemec, or DuraPlate 5900 Mortar, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
3. Glass Flake Modified Polyamine Epoxy
- a. Usage: Abrasion resistant, high solids, epoxy coating which offers high-build edge protection and excellent corrosion resistance. Contains glass flake and aluminum oxide for improved film integrity.
 - b. Exposure: Severe.
 - c. Number of Coats: See schedule.
 - d. Minimum Solids Content: $82.0 \pm 2.0\%$
 - e. Minimum Dry Film Thickness Per Coat: 8 -18 mils DFT
 - f. Epoxoline, Series 142, as manufactured by Tnemec, or Macropoxy 5500LT, as manufactured by Sherwin Williams.
 - g. Primer: See schedule.
4. Modified Polyamine Epoxy
- a. Usage: NSF Approved, abrasion resistant, high solids, epoxy coating which offers high-build edge protection and excellent corrosion resistance.
 - b. Exposure: Severe.
 - c. Number of Coats: See schedule.
 - d. Minimum Solids Content: $82.0 \pm 2.0\%$
 - e. Minimum Dry Film Thickness Per Coat: 4 -18 mils DFT
 - f. Epoxoline, Series 141, as manufactured by Tnemec, or Macropoxy 5500LT, as manufactured by Sherwin Williams.
 - g. Primer: See schedule.
5. Surface Tolerant Modified Polyamidoamine Epoxy
- a. Usage: High-build coating with superior wetting for marginally prepared rusty steel and tightly adhering old coatings. Excellent abrasion-, chemical- and corrosion-resistance. Perfect foundation for aliphatic-polyurethanes. NOT FOR IMMERSION SERVICE.
 - b. Exposure: Moderate.
 - c. Number of Coats: See schedule.
 - d. Finish: Semi-gloss.
 - e. Minimum Solids Content: $84.0 \pm 2.0\%$ (mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Chembuild, Series 135, as manufactured by Tnemec, or Macropoxy 5500 LT, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.

6. NSF Approved Pure Polyamide Epoxy
 - a. Usage: Potable water coating which offers high-build edge protection and allows for application at a wide range of temperatures (down to 35°F or 2°C). For use on the interior and exterior of steel or concrete tanks, reservoirs, pipes, valves, pumps and equipment in potable water service.
 - b. NSF Certification: Yes
 - c. Exposure: Moderate.
 - d. Number of Coats: See schedule.
 - e. Minimum Solids Content: $56.0 \pm 2.0\%$
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Pota-Pox, Series 20 or 20HS, as manufactured by Tnemec, or Macropoxy 646 PW, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
7. Polyamidoamine Epoxy
 - a. Usage: Potable water and wastewater primer which offers high-build edge protection and allows for application at a wide range of temperatures (down to 35°F or 2°C). For use on the interior and exterior of steel or concrete tanks, reservoirs, pipes, valves, pumps and equipment in potable water service.
 - b. Exposure: Moderate.
 - c. Number of Coats: See schedule.
 - d. Color: 1211 Red – Ductile Iron Pipe
 - e. Minimum Solids Content: $67.0 \pm 2.0\%$ (mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Pota-Pox Plus, Series N140, as manufactured by Tnemec, or Macropoxy 5500LT, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
8. High-Build Epoxy Coating – Pure Polyamide Epoxy
 - a. Usage: Application characteristics in adverse and varied conditions.
 - b. Exposure: Moderate.
 - c. Number of Coats: See schedule.
 - d. Finish: Satin.
 - e. Minimum Solids Content: $56.0\% \pm 2.0\%$ (mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Hi-Build Epoxoline , Series 66 or 66HS, as manufactured by Tnemec, or Macropoxy 646 Fast Cure, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
9. Waterborne Acrylic Epoxy
 - a. Usage: High performance coating suitable for concrete, steel and other commonly used building materials. Features include high-build, low odor, non-yellowing white and fade resistant colors; easy cleanup and stain-, abrasion-, chemical- and moisture-resistance. Good exterior performance.
 - b. Exposure: Moderate
 - c. Number of Coats: See schedule.

- d. Color: Refer to Tnemec Color Guide.
- e. Finish: Satin.
- f. Minimum Solids Content: $44.0 \pm 2.0\%$ (mixed)
- g. Minimum Dry Film Thickness Per Coat: See schedule.
- h. H.B. Tneme-Tufcoat, Series 113, as manufactured by Tnemec, or Pro Industrial Water Based Epoxy.
- i. Primer: See schedule.

10. Modified Polyamine Epoxy

- a. Usage: High-solids moisture tolerant epoxy used for priming concrete, wood and drywall. Also as a stand-alone one-coat clear floor sealer.
- b. Exposure:
- c. Number of Coats: See schedule.
- d. Color: Clear. Can be field-tinted (Series 820 Field Tint) in 16 StrataShield colors and certain custom colors. Sherwin Williams products is available in clear standard and customer colors
- e. Minimum Solids Content: 100% (mixed).
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Epoxoprime, Series 201, as manufactured by Tnemec, or General Polymers 3746, as manufactured by Sherwin Williams.
- h. Primer: See schedule.

11. Modified Polyamine Epoxy

- a. Usage: A multi-purpose epoxy coating that can be used as a primer, broadcast, slurry/broadcast, mortar, grout coat, and topcoat. Excellent application properties with good flow and self-leveling characteristics. Protects concrete surfaces from impact, abrasion and mild chemicals.
- b. Exposure: Moderate.
- c. Number of Coats: See schedule.
- d. Color: Clear or pigmented. Can be factory or field-tinted (Series 820 Field Tint) in 16 StrataShield colors and certain custom colors. Reference Sherwin Williams data sheets for color details
- e. Minimum Solids Content: 100% (mixed).
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Power-Tread, Series 237, as manufactured by Tnemec, or General Polymers 4080 (FasTop 12S), as manufactured by Sherwin Williams.
- h. Primer: See schedule.

12. Modified Novolac Epoxy

- a. Usage: A multi-purpose resin for fiberglass reinforced mat secondary containment systems. Protects against chemicals, thermal cycling, impact and abrasion.
- b. Exposure: Severe/moderate
- c. Number of Coats: See schedule.
- d. Color: 00GR Gray or clear from Sherwin Williams.
- e. Minimum Solids Content: 100% (mixed)
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Chembloc, Series 239SC, as manufactured by Tnemec, or Cor-Cote HCR, as manufactured by Sherwin Williams.

- h. Primer: See schedule.

C. Polyurethane Coating:

1. Modified Aromatic Polyurethane Primer

- a. Usage: A single component, surface tolerant, NSF approved, moisture-cured resin, containing micaceous iron oxide and zinc to function as a primer which is field and shop friendly. Exposure: Moderate.
- b. Number of Coats: See schedule.
- c. Color: 1216 Greenish-Gray.
- d. Minimum Solids Content: $61.0 \pm 2.0\%$ (mixed).
- e. Minimum Dry Film Thickness Per Coat: See schedule.
- f. Omnithane, Series 1, as manufactured by Tnemec, or Corothane 1 GalvaPac 1K or 2K Zinc Primer, as manufactured by Sherwin Williams.
- g. Primer: See schedule.

2. Aromatic Urethane, Zinc-Rich Primer

- a. Usage: A two-component, moisture-cured, zinc-rich urethane primer for the interior and exterior steel surfaces. Exposure: Moderate.
- b. Color: Greenish-gray.
- c. Minimum Solids Content: $63.0 \pm 2.0\%$ (mixed).
- d. Metallic Zinc Content: 83% minimum in dried film. ASTM D 522 Type III Zinc dust.
- e. Standard of Quality: Hydro-Zinc, Series 91-H₂O, as manufactured by Tnemec, or Corothane 1 GalvaPac 1K or 2K Zinc Primer, as manufactured by Sherwin Williams.
- f. Primer: See schedule.

3. Aliphatic Acrylic Polyurethane

- a. Usage: A coating highly resistant to abrasion, wet conditions, corrosive fumes and exterior weathering. High build quality combines with project specific primers for two-coat, labor saving systems. Fast curing options are available; see Curing Time below. NOT FOR IMMERSION SERVICE.
- b. Exposure: Moderate.
- c. Number of Coats: See schedule.
- d. Finish: Gloss.
- e. Minimum Solids Content: $66 \pm 2.0\%$ (mixed).
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Endura-Shield, Series 1095, as manufactured by Tnemec, or Acolon 218 HS, as manufactured by Sherwin Williams.
- h. Primer: See schedule.

4. Aliphatic Moisture Cured Urethane

- a. Usage: Extremely hard, chemical-resistant urethane floor coating with superb wear characteristics. Excellent resistance to abrasion, wet conditions, corrosive fumes and chemical contact. Excellent gloss and color retention. Low odor characteristic allows for use near occupied space. Note: For horizontal surfaces only.
 - b. Exposure: Moderate.
 - c. Number of Coats: See schedule.
 - d. Finish: Semi-gloss.
 - e. Minimum Solids Content: $92 \pm 2.0\%$ (clear mixed).
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Everthane, Series 248, as manufactured by Tnemec, or Amorseal Rextthane 1, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
5. Polyurethane Modified Concrete
- a. Usage: High performance designed to reduce moisture vapor emissions prior to the application of non-breathing, polymer floor topping finishes. Must be able to withstand up to 20lbs moisture vapor transmission and 99% RH.
 - b. Exposure: Moderate/Severe
 - c. Number of Coats: See schedule.
 - d. Finish: Matt.
 - e. Minimum Solids Content: 100%.
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Everthane, Series 241 MVT, as manufactured by Tnemec, or General Polymers FasTop 12S, as manufactured by Sherwin Williams..
 - h. Primer: See schedule.

D. Alkyd Coating:

1. Alkyd
- a. Usage: High gloss industrial enamel offering good flow, hiding and protection for recommended surfaces in mild to moderately severe exposures. Not for use on surfaces that are continually wet or sweat frequently.
 - b. Exposure: Mild to moderately severe.
 - c. Number of Coats: See schedule.
 - d. Finish: Gloss.
 - e. Minimum Solids Content: $49.0 \pm 2.0\%$.
 - f. Minimum Dry Film Thickness Per Coat: See schedule.
 - g. Hi-Build Tnemec-Gloss, Series 2H, as manufactured by Tnemec, or Industrial Enamel, as manufactured by Sherwin Williams.
 - h. Primer: See schedule.
2. Phenolic Alkyd
- a. Usage: Lead- and chromate-free, fast-drying, corrosion-resistant primer that accepts a variety of high-performance topcoats. Ideally suited for steel fabricators, OEM's and field applications where "dry-fall" characteristics are desired. Note: Not recommended for immersion.
 - b. Exposure: Moderate.

- c. Number of Coats: See schedule.
- d. Color: 77 Red or 78 Gray.
- e. Minimum Solids Content: $58.0 \pm 2.0\%$.
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Chem-Prime H.S., Series 37H, as manufactured by Tnemec, or Kem Bond HS Primer, as manufactured by Sherwin Williams.
- h. Primer: See schedule.

E. Acrylic

1. HDP Acrylic Polymer

- a. Usage: Water-based, low VOC, High Dispersion Pure acrylic polymer coating providing excellent long term protection in both interior/exterior exposures. May be applied by spray, brush or roller over a variety of solvent and waterborne steel primers. May also be used over many aged coatings. It is mildew resistant and exhibits very good gloss and color stability. Application methods include "dry-fall" under certain conditions (See Application). Note: Series 1029's "dry-fall" characteristics help reduce the potential for overspray problems on buildings and surrounding property.
- b. Exposure: Moderate.
- c. Number of Coats: See schedule.
- d. Color: Refer to Tnemec Color Guide.
- e. Minimum Solids Content: $40.0 \pm 2.0\%$.
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Enduratone, Series 1029, as manufactured by Tnemec, or SherCryl HPA, as manufactured by Sherwin Williams.
- h. Primer: See schedule.

2. Modified Waterborne Acrylate

- a. Usage: Flexible, breathable coating primarily for concrete and masonry that can fill and bridge minor hairline cracks. Excellent elastomeric protection against driving rain, alternate freezing-thawing and UV light. Series 156 can also be used as a low cohesive stress overcoat for aged oil or alkyd systems.
- b. Exposure: Moderate.
- c. Number of Coats: See schedule.
- d. Color: Refer to Tnemec Color Guide.
- e. Minimum Solids Content: $50.9 \pm 2.0\%$
- f. Minimum Dry Film Thickness Per Coat: See schedule.
- g. Enviro-Crete, Series 156, as manufactured by Tnemec, or ConFlex XL Smooth, as manufactured by Sherwin Williams.
- h. Primer: See schedule.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Examine areas and conditions under which application of coating systems shall be performed for conditions that will adversely affect execution, permanence, or quality of coating system application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes until moisture content of surface is below following limits:
 - 1. Masonry Surfaces: 12% maximum
 - 2. Vertical Concrete Surfaces: 12% maximum
 - 3. Horizontal Concrete Surfaces: 8% maximum
- D. Correct conditions detrimental to timely and proper execution of Work.
- E. Do not proceed until unsatisfactory conditions have been corrected.
- F. Commencement of installation constitutes acceptance of conditions and responsibility for satisfactory performance.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Protection:
 - 1. Take precautionary measures to prevent fire hazards and spontaneous combustion. Remove empty containers from Site.
 - 2. Place cotton waste, cloths and hazardous materials in containers, and remove from Site daily.
 - 3. Provide drop cloths, shields, and other protective equipment.
 - 4. Protect elements surrounding work of this section from damage or disfiguration.
 - 5. As Work proceeds, promptly remove spilled, splashed, or splattered materials from surfaces.
 - 6. During application of coating materials, post Wet Paint signs.
 - 7. During application of solvent-based materials, post No Smoking signs.
- C. Clean surfaces of loose foreign matter.
- D. Remove substances that would bleed through finished coatings; if removal is not possible, seal surface with shellac.
- E. Remove finish hardware, fixture covers, and accessories and store.

F. Existing Painted and Sealed Surfaces:

1. Remove loose, flaking, and peeling paint, and feather edge and sand smooth edges of chipped paint.
2. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.

G. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Surfaces shall be mechanically cleaned to remove passivation and to provide a uniform 1.0 mil anchor profile.

H. Ferrous Metal:

1. Surfaces shall be free of residual deposits of grease, rust, scale, dirt, dust, and oil.
 - a. Immersion Service: SSPC-SP 10 Near White Blast Cleaning
 - b. Non-Immersion Service: SSPC-SP 6 Commercial Blast Cleaning..
2. Field Repair of Shop Primed Surfaces:
 - a. Non-Immersion Service: Remove all dirt, dust, chalk, oil, grease, as well as any other foreign matter by solvent cleaning (SSPC-SP 1) and/or power washing. All areas damaged during transportation, construction or installation shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal or SSPC-SP 6 Commercial Blast Cleaning. All edges shall be feathered. All surfaces shall be clean and dry prior to coating
 - b. Immersion Service: Remove all dirt, dust, chalk, oil, grease, as well as any other foreign matter by solvent cleaning (SSPC-SP 1) and/or power washing. All areas damaged during transportation, construction or installation shall be cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All edges shall be feathered. The remainder of the intact shop primer shall be cleaned in accordance with SSPC-SP 7 Brush-Off Blast Cleaning to provide a minimum, uniform, anchor profile of at least 1.0 mil. In order to prevent injury to surrounding painted areas, blast cleaning may necessitate use of lower air pressure, small nozzle and abrasive particle sizes, short blast nozzle distance from surface, shielding and masking. If damage is too extensive to touch-up, item shall be re-cleaned and coated or painted. All surfaces shall be clean and dry prior to receiving the specified finish coat(s).
3. For surfaces not shop primed, surfaces shall be cleaned in compliance with specifications of Steel Structures Painting Council as indicated in Schedule of Coating Systems below.

3.3 APPLICATION

- A. Comply with MPI - Architectural Painting Manual.
- B. Apply primer to each surface, unless specifically not required by coating manufacturer.
- C. Apply coating systems in compliance with manufacturer's instructions and using application method best suited for obtaining full, uniform coverage of surfaces to be coated.

- D. Apply primer, intermediate, and finish coats to comply with wet and dry film thickness and spreading rates for each type of material as recommended by manufacturer.
 - 1. Application rates in excess of those recommended and fewer numbers of coats than specified shall not be accepted.
- E. Number of coats specified shall be minimum number acceptable. Apply additional coats as needed to provide a smooth, even application.
 - 1. Closely adhere to re-coat times recommended by manufacturer. Allow each coat to dry thoroughly before applying next coat. Provide adequate ventilation for tank interior to carry off solvents during drying phase.
- F. Employ only application equipment that is clean, properly adjusted, and in good working order, and of type recommended by coating manufacturer.
- G. After surface preparation, interior weld seams shall receive a stripe coat applied by brush.
- H. Make edges of paint adjoining other materials or colors sharp and clean, without overlapping.
- I. Apply coatings to specified thicknesses.
- J. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish.
- K. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspecting and Testing: Comply with MPI - Architectural Painting Manual.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Collect waste material that may constitute fire hazard, place in closed metal containers, and remove daily from Site.
- C. Clean surfaces immediately of overspray, splatter, and excess material.
- D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6 SCHEDULE

A. INTERIOR SERVICE

*Interior service refers to the interior of buildings and rooms and not the interior of tanks, structures, etc.

1. Interior Exposed Ferrous Metals: 16 gauge or heavier

a. Shop primed; field applied finish coats or field applied system

- 1) Surface Preparation: SSPC SP10 Near White Blast Cleaning
- 2) Primer/Shop Coat:
 - a) Tnemec: Series 91 H20 Hydro-Zinc
 - b) Sherwin Williams: GalvaPac 1K or 2K Zinc Primer ^{Note (1)}
 - c) Carboline: Carbomastic 615
 - d) Dry Film Thickness: 2.5 – 3.5 mils (Carboline: 5.0 - 10.0)
- 3) First Coat:
 - a) Tnemec: Series 66 Epoxoline
 - b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (2), (3)}
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 3.0 – 5.0 mils (Carboline: 4.0 - 6.0)
- 4) Finish Coat:
 - a) Tnemec: Series 1095 Endura-Shield
 - b) Sherwin Williams: Acolon 218 HS
 - c) Carboline: Carbothane 8845
 - d) Dry Film Thickness: 2.0 – 3.0 mils (Carboline: 3.0 - 5.0)
- 5) Total Dry Film Thickness: 6.5 to 9.5 mils

Note (1) Coordinate shop cleaning and primer coat with appropriate Metals Specifications.

Note (2) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21 degrees C) or when faster recoat is desired.

Note (3) 66HS Epoxoline may be substituted for 66 Epoxoline.

2. Lightweight Metals: (18 gauge or lighter)

- a. Shop primed; field applied finish coats or field applied system
- b. Surface Preparation: For Galvanized Metal, Aluminum, Other Non-Ferrous Metals. Etch entire surface using Clean & Etch by Great Lakes Laboratories. For Ferrous Metals clean per SSPC- SP3 Power Tool Cleaning
 - 1) Primer/Shop Coat: Manufacturers Standard Type Primer Compatible with finish coats below

- a) Perform crosshatch field adhesion test per ASTM D 3359 to determine compatibility of manufacturer's primer with herein specified coating system prior to coating system application.
 - 2) First Coat:
 - a) Tnemec: Series 37H-77 Chemprime
 - b) Sherwin Williams: Kem Bond HS Primer
 - c) Carboline: Sanitile 120
 - d) Dry Film Thickness: 2.0 - 3.0 mils (Carboline: 1.0 - 2.0)
 - 3) Intermediate Coat:
 - a) Tnemec: Series 2H Tneme-Gloss
 - b) Sherwin Williams: Industrial Enamel
 - c) Carboline: Carbocoat 8215
 - d) Dry Film Thickness: 2.0 - 3.0 mils
 - 4) Finish Coat:
 - a) Tnemec: Series 2H Tneme-Gloss
 - b) Sherwin Williams: Industrial Enamel
 - c) Carboline: Carbocoat 8215
 - d) Dry Film Thickness: 2.0 - 3.0 mils
 - 5) Total Dry Film Thickness: 6.0 to 9.0 mils (excluding shop primer coat)
3. Non-Submerged Ductile Iron:
- a. Surface Preparation: Abrasive blast to remove all contaminants.
 - 1) Primer:
 - a) Tnemec: Series N140-1211 Pota-Pox Plus
 - b) Sherwin Williams: Macropoxy 5500LT
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 6.0 – 8.0 (Carboline: 4.0 - 6.0)
 - 2) Intermediate:
 - a) Tnemec: Series 66 Epoxoline
 - b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (1), (2)}
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 3.0 – 5.0 (Carboline: 4.0 - 6.0)
 - 3) Finish Coat:
 - a) Tnemec: Series 1095 Endura-Shield
 - b) Sherwin Williams: Acrolon 218 HS
 - c) Carboline: Carbothane 8845
 - d) Dry Film Thickness: 2.0 – 3.0

4) Total Dry Film Thickness: 11.0 – 16.0

Note (1) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired

Note (2) 66HS Epoxoline may be substituted for 66 Epoxoline.

4. Non-Submerged Ferrous Metals & Ductile Iron (Frequently Sweating Pipe):

a. Surface Preparation: Abrasive blast to remove all contaminants. Shop primed surfaces shall be scarified prior to application of the intermediate coat.

1) Primer:

- a) Tnemec: Series N140-1211 Pota-Pox Plus
- b) Sherwin Williams: Macropoxy 5500 LT
- c) Dry Film Thickness: 6.0 – 8.0

2) Intermediate:

- a) Tnemec: Series 20 Pota-Pox
- b) Sherwin Williams: Macropoxy 646 Fast Cure
- c) Dry Film Thickness: 4.0 – 6.0

3) Insulation Coating:

- a) Tnemec: Series 971 Aerolon
- b) Sherwin Williams: Heat Flex 3500
- c) Dry Film Thickness: 100 - 150

4) Finish Coat:

- a) Tnemec: Series 72T Endura-Shield
- b) Sherwin Williams: SherCryl HPA
- c) Dry Film Thickness: 2.0 – 3.0

5) Total Dry Film Thickness: 11.0 – 16.0

5. Non-Submerged Ferrous Metals & Ductile Iron (Thermal Resistance Up to 325°F):

a. Surface Preparation: SSPC-SP6/NACE No. 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils. ^{Note (1)}

1) 1st Coat:

- a) Tnemec: Series 1224 Epoxoline WB5
- b) Sherwin Williams: Heat Flex 1200
- c) Dry Film Thickness: 5.0 – 8.0

2) 2nd Coat:

- a) Tnemec: Series 971 Aerolon Acrylic
- b) Sherwin Williams: Heat Flex 3500

- c) Dry Film Thickness: 50.0
- 3) 3rd Coat:
 - a) Tnemec: Series 971 Aerolon Acrylic
 - b) Sherwin Williams: Heat Flex 3500
 - c) Dry Film Thickness: 50.0
- 4) 4th Coat:
 - a) Tnemec: Series 72T EnduraShield
 - b) Sherwin Williams: SherCryl HPA
 - c) Dry Film Thickness: 2.0 – 5.0
- 5) Total Dry Film Thickness: 109.0 – 113.0

Note (1) Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1224 may be applied to SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces

Note(2) Apply Heat Flex 3500 in accordance with manufacturer's product data sheet to achieve recommended dry film thickness.

6. Non-Submerged Ferrous Metals & Ductile Iron (Thermal Resistance For Freezing Substrates):

- a. Surface Preparation: SSPC-SP6/NACE No. 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils. ^{Note (1)}

- 1) 1st Coat:
 - a) Tnemec: Series 1224 Epoxoline WB5
 - b) Sherwin Williams: Heat Flex 1200
 - c) Dry Film Thickness: 5.0 – 8.0
- 2) 2nd Coat:
 - a) Tnemec: Series 971 Aerolon Acrylic
 - b) Sherwin Williams: Heat Flex 3500
 - c) Dry Film Thickness: 50.0
- 3) 3rd Coat:
 - a) Tnemec: Series 971 Aerolon Acrylic
 - b) Sherwin Williams: Heat Flex 3500
 - c) Dry Film Thickness: 50.0
- 4) 4th Coat:
 - a) Tnemec: Series 971 Aerolon Acrylic
 - b) Sherwin Williams: Heat Flex 3500
 - c) Dry Film Thickness: 50.0
- 5) 5th Coat:

- a) Tnemec: Series 72T EnduraShield
- b) Sherwin Williams: SherCryl HPA
- c) Dry Film Thickness: 2.0 – 5.0

6) Total Dry Film Thickness: 159.0 – 163.0

Note (1) Abrasive blast cleaning generally produces the best coating performance. If conditions will not permit this, Series 1224 may be applied to SSPC-SP2 or SSPC-SP3 Hand or Power Tool Cleaned surfaces

Note(2) Apply Heat Flex 3500 in accordance with manufacturer's product data sheet to achieve recommended dry film thickness.

7. Previously Painted Non-Submerged Ferrous Metals & Ductile Iron:

- a. Surface Preparation: Clean all surfaces of all dirt, dust, chalk, and any other foreign matter that may interfere with the adhesion of the proposed coating system. Clean all corroded areas in accordance with SSPC-SP 3 Power Tool Cleaning. Feather Edges. Spot Prime all areas cleaned to bare metal.

1) Spot Prime:

- a) Tnemec: Series 135 Chembuild
- b) Sherwin Williams: Macropoxy 5500 LT
- c) Carboline: Carboguard 635
- d) Dry Film Thickness: 3.0 – 5.0 (Carboline: 4.0 - 6.0)

2) Full Prime:

- a) Tnemec: Series 135 Chembuild
- b) Sherwin Williams: Macropoxy 5500 LT
- c) Carboline: Carboguard 635
- d) Dry Film Thickness: 2.0 – 3.0 (Carboline: 4.0 - 6.0)

3) Finish Coat:

- a) Tnemec: Series 1095 Endura-Shield
- b) Sherwin Williams: Acrolon 218 HS
- c) Carboline: Carbothane 8845
- d) Dry Film Thickness: 2.0 – 3.0 (Carboline: 3.0 - 5.0)

8. Concrete Masonry Block:

- a. Surface Preparation: Clean and Dry

1) First Coat:

- a) Tnemec: Series 130 Envirofill
- b) Sherwin Williams: Cement-Plex 875
- c) Carboline: Sanitile 100
- d) Dry Film Thickness: 65-85 sq ft/gallon (Carboline: 12 mils)

2) Second Coat:

- a) Tnemec: Series 113 Tneme-Tufcoat
 - b) Sherwin Williams: Pro Industrial Water Based Epoxy
 - c) Carboline: Sanitile 555
 - d) Dry Film Thickness: 4.0 – 6.0 mils
 - 3) 4. Third Coat:
 - a) Tnemec: Series 297 Enviro-Glaze
 - b) Sherwin Williams: Pro Industrial Water Based Acrolon 100
 - c) Carboline: Sanitile 555
 - d) Dry Film Thickness: 2.0 – 3.0 mils
9. Concrete:
 - a. Surface Preparation: Clean and Dry. Mechanically abrade to remove laitance layer and to provide a uniform 1.0 mil anchor profile.
 - 1) First Coat:
 - a) Tnemec: Series 215 Surfacing Epoxy
 - b) Sherwin Williams: Steel Seam FT910 – To fill holes
 - c) Dry Film Thickness: N/A
 - 2) Second Coat:
 - a) Tnemec: 113 Tneme-Tufcoat
 - b) Sherwin Williams: Pro Industrial Water Based Epoxy
 - c) Dry Film Thickness: 4.0 – 6.0 mils
 - 3) Third Coat:
 - a) Tnemec: 297 Enviro-Glaze
 - b) Sherwin Williams: Pro Industrial Water Based Acrolon 100
 - c) Dry Film Thickness: 2.0 – 3.0 mils
 - 4) Total Dry Film Thickness: 6.0 – 9.0 mils
10. Concrete Floors (Clear Sealer):
 - a. Surface Preparation: All surfaces shall be free of all coatings, sealers, etc. Pressure wash to remove loose material and contamination.
 - 1) First Coat:
 - a) Tnemec: Series 629 CT Densifyer 201
 - b) Sherwin Williams: H&C Pro Series Endurapolish Waterbased Clear Hardener & Densifyer
 - c) Carboline: Carbocrete Sealer WB (DFT: 1.0 – 3.0 mils)
 - d) Coverage Rate: 300-350 sq. ft. per gallon
 - 2) Second Coat:

- a) Tnemec: Series 629 CT Densifyer 201
- b) Sherwin Williams: H&C Pro Series Endurapolish Waterbased Clear Hardener & Densifyer
- c) Coverage Rate: 350-400 sq. ft. per gallon

11. Gypsum Wallboard

a. Surface Preparation: Clean and dry.

1) First Coat:

- a) Tnemec: Series 1026 Enduratone
- b) Sherwin Williams: ProMar 200 Zero VOC Interior Latex Primer
- c) Dry Film Thickness: 2.0 – 3.0 mils

2) Second Coat:

- a) Tnemec: Series 1026 Enduratone
- b) Sherwin Williams: SherCryl HPA
- c) Dry Film Thickness: 2.0 – 3.0 mils

3) Third Coat:

- a) Tnemec: Series 1026 Enduratone
- b) Sherwin Williams: SherCryl HPA
- c) Dry Film Thickness: 2.0 – 3.0 mils

4) Total Dry Film Thickness: 6.0 – 9.0 mils

12. Wood

a. Surface Preparation: Clean and dry.

1) First Coat:

- a) Tnemec: Series 1099W Tnemec Primer
- b) Sherwin Williams: PrepRite Interior/Exterior Latex Primer/Sealer
- c) Carboline: (Opaque finish) Sanitile 120
- d) Dry Film Thickness: 2.0 – 3.0 mils (Carboline: 1.0 - 2.0)

2) Second Coat:

- a) Tnemec: Series 1029 Enduratone
- b) Sherwin Williams: SherCryl HPA
- c) Carboline: (Opaque finish) Carbocoat 8215
- d) Dry Film Thickness: 2.0 – 3.0 mils

3) Third Coat:

- a) Tnemec: Series 1029 Enduratone
- b) Sherwin Williams: SherCryl HPA

- c) Carboline: (Opaque finish) Carbocoat 8215
- d) Dry Film Thickness: 2.0 – 3.0 mils

4) Total Dry Film Thickness: 6.0 – 9.0 mils

13. Interior Drywall Located in General Areas

a. Primer Coat

- 1) Carboline: Sanitile 120
- 2) Dry Film Thickness: 1.0 - 2.0

b. First Coat

- 1) Carboline: Carbocrylic 3359
- 2) Dry Film Thickness: 2.0 - 3.0 mils

c. Finish Coat:

- 1) Carboline: Carbocrylic 3359
- 2) Dry Film Thickness: 2.0 - 3.0 mils

14. Interior Overhead Locations in Dry Areas

a. Prime Coat:

- 1) Carboline: Carbocrylic 3359DTM
- 2) Dry Film Thickness: 2.0 – 3.0 mils per coat; 3.0 – 5.0 mils per coat

B. EXTERIOR SERVICE

*All coating thickness are expressed in dry film thickness (DFT.)

1. Exterior Exposed Ferrous Metals: 16 gauge or heavier

- a. Shop primed; field applied finish coat or field applied system
- b. Surface Preparation: SSPC SP6 Commercial Blast Cleaning

1) Primer/Shop Coat:

- a) Tnemec: Series 91 H2O Hydro-Zinc
- b) Sherwin Williams: Corothane 1 GalvaPac 1K or 2K Zinc Primer ^{Note}
(1)
- c) Carboline: Carbozinc 859
- d) Dry Film Thickness: 2.5 to 3.5 mils (Carboline: 3.0 - 5.0)

2) First Coat:

- a) Tnemec: Series 66 Epoxoline
- b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (2),(3)}

- c) Carboline: Carbocoat 635
- d) Dry Film Thickness: 3.0-5.0 mils

3) Finish Coat:

- a) Tnemec: Series 1095 Endura-Shield II
- b) Sherwin Williams: Acrolon 218HS
- c) Carboline: Carbothane 8845
- d) Dry Film Thickness: 2.0-3.0 mils (Carboline: 3.0 - 5.0)

c. Total Dry Film Thickness: 6.5 to 9.5 mils

Note (1) Coordinate shop cleaning and primer coat with appropriate Metals Specifications

Note (2) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired.

Note (3) 66HS Epoxoline may be substituted for 66 Epoxoline.

2. Exterior Exposed Ferrous Metals: Digester Covers, etc.

- a. Shop primed; field applied finish coat or field applied system
- b. Surface Preparation: SSPC SP6 Commercial Blast Cleaning

1) Primer/Shop Coat:

- a) Tnemec: : Series 91 H20 Hydro-Zinc
- b) Sherwin Williams: Corothane 1 GalvaPac 1K or 2K Zinc Primer ^{Note}₍₁₎
- c) Carboline: Carbozinc 859
- d) Dry Film Thickness: 2.5 to 3.5 mils (Carboline: 3.0 - 5.0)

2) First Coat:

- a) Tnemec: Series 66 Epoxoline
- b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (2),(3)}
- c) Carboline: Carbocoat 635
- d) Dry Film Thickness: 3.0 – 5.0

3) Finish Coat:

- a) Tnemec: Series 700-35GR HydroFlon Endura-Shield II
- b) Sherwin Williams: FluoroKem HS
- c) Carboline: Carbothane 8845
- d) Dry Film Thickness: 2.0 – 3.0 mils (Carboline: 3.0 - 5.0)

4) Total Dry Film Thickness: 6.5 to 9.5 mils

Note (1) Coordinate shop cleaning and primer coat with appropriate Metals Specifications

Note (2) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired.

Note (3) 66HS Epoxoline may be substituted for 66 Epoxoline.

3. Exterior Exposed Galvanized Metals:

- a. Surface Preparation: Remove all soluble and insoluble contaminants and corrosion. Abrasive (sweep) blast in accordance with ASTM D 6386 to provide a uniform anchor profile (1.0 – 2.0 mils)

1) First Coat:

- a) Tnemec: Series 66 Epoxoline
- b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (1), (2)}
- c) Carboline: Carboguard 60
- d) Dry Film Thickness: 2.0 – 3.0 mils (Carboline: 4.0 - 6.0 mils)

2) Finish Coat:

- a) Tnemec: Series 1095 Endura-Shield
- b) Sherwin Williams: Acrolon 218 HS
- c) Carboline: Carbothane 8845
- d) Dry Film Thickness: 2.0 - 3.0 mils (Carboline: 3.0 - 5.0)

3) Total Dry Film Thickness: 4.0 – 6.0 mils

Note (1) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired.

Note (2) 66HS Epoxoline may be substituted for 66 Epoxoline.

4. Lightweight Metals: Factory Primer Ferrous Metals (18 gauge or lighter)

- a. Surface Preparation: SSPC-SP 3 Power Tool Cleaning
- b. Primer/Shop Coat: Manufacturers Standard Type Primer Compatible with finish coats below. Perform crosshatch field adhesion test per ASTM D 3359 to determine compatibility of manufacturer's primer with herein specified coating system prior to coating system application

1) First Coat:

- a) Tnemec: Series 37H-77 Chemprime
- b) Sherwin Williams: Kem Bond HS Primer
- c) Carboline: Sanitile 120
- d) Dry Film Thickness: 2.0-3.0 mils (Carboline: 1.0 - 2.0)

2) Intermediate Coat:

- a) Tnemec: Series 2H Tneme-Gloss
- b) Sherwin Williams: Industrial Enamel
- c) Carboline: Carbocoat 8215
- d) Dry Film Thickness: 2.0-3.0 mils

3) Finish Coat:

- a) Tnemec: Series 2H Tneme-Gloss
- b) Sherwin Williams: Industrial Enamel
- c) Carboline: Carbocoat 8215
- d) Dry Film Thickness: 2.0-3.0 mils

- 4) Total Dry Film Thickness: 6.0 to 9.0 mils (excluding shop primer coat)
5. Previously Painted Non-Submerged Ferrous Metals & Ductile Iron:
 - a. Surface Preparation: Clean all surfaces of all dirt, dust, chalk, and any other foreign matter that may interfere with the adhesion of the proposed coating system. Clean all corroded areas in accordance with SSPC-SP 3 Power Tool Cleaning. Feather Edges. Spot Prime all areas cleaned to bare metal.
 - 1) Spot Prime:
 - a) Tnemec: Series 135 Chembuild
 - b) Sherwin Williams: Macropoxy 5500 LT
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 3.0 – 5.0 (Carboline: 4.0 - 6.0)
 - 2) Full Prime:
 - a) Tnemec: Series 135 Chembuild
 - b) Sherwin Williams: Macropoxy 5500 LT
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 2.0 – 3.0 (Carboline: 4.0 - 6.0)
 - 3) Finish Coat:
 - a) Tnemec: Series 1095 Endura-Shield
 - b) Sherwin Williams: Acrolon 218 HS
 - c) Carboline: Carbothane 8845
 - d) Dry Film Thickness: 2.0 – 3.0 (Carboline: 3.0 - 5.0)
6. Non-Submerged Ductile Iron:
 - a. Surface Preparation: Abrasive blast to remove all contaminants.
 - 1) Primer:
 - a) Tnemec: Series N140-1211 Pota-Pox Plus
 - b) Sherwin Williams: Macropoxy 5500 LT
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 6.0 – 8.0 (Carboline: 4.0 - 6.0)
 - 2) Intermediate:
 - a) Tnemec: Series 66 Epoxoline
 - b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (1), (2)}
 - c) Carboline: Carboguard 635
 - d) Dry Film Thickness: 3.0 – 5.0 (Carboline: 4.0 - 6.0)
 - 3) Finish Coat:

- a) Tnemec: Series 1095 Endura-Shield
- b) Sherwin Williams: Acrolon 218 HS
- c) Carboline: Carbothane 8845
- d) Dry Film Thickness: 2.0 – 3.0 (Carboline: 3.0 - 5.0)

4) Total Dry Film Thickness: 11.0 – 16.0

Note (1) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired

Note (2) 66HS Epoxoline may be substituted for 66 Epoxoline.

7. Insulative Coatings – Thermal Resistance - Non-Submerged Ferrous Metals & Ductile Iron (Frequently Sweating Pipe):

- a. Surface Preparation: Abrasive blast to remove all contaminants. Shop primed surfaces shall be scarified prior to application of the intermediate coat.

1) Primer:

- a) Tnemec: Series N140-1211 Pota-Pox Plus
- b) Sherwin Williams: Macropoxy 5500 LT
- c) Dry Film Thickness: 6.0 – 8.0

2) Intermediate:

- a) Tnemec: Series 20 Pota-Pox
- b) Sherwin Williams: Macropoxy 646 Fast Cure
- c) Dry Film Thickness: 4.0 – 6.0

3) Insulation Coating:

- a) Tnemec: Series 971 Aerolon
- b) Sherwin Williams: Heat Flex 3500
- c) Dry Film Thickness: 100-150

4) Finish Coat:

- a) Tnemec: Series 72T Endura-Shield
- b) Sherwin Williams: SherCryl HPA
- c) Dry Film Thickness: 2.0 – 3.0

5) Total Dry Film Thickness: 11.0 – 16.0

8. Non-Submerged Ductile Iron (Coastal Exposure/Extreme UV):

- a. Surface Preparation: Abrasive blast to remove all contaminants.

1) Primer:

- a) Tnemec: Series N140-1211 Pota-Pox Plus
- b) Sherwin Williams: Macropoxy 5500 LT
- c) Dry Film Thickness: 6.0 – 8.0

2) 1st Intermediate:

- a) Tnemec: Series 66 Epoxoline
- b) Sherwin Williams: Macropoxy 646 Fast Cure ^{Note (1), (2)}
- c) Dry Film Thickness: 3.0 – 5.0

3) 2nd Intermediate:

- a) Tnemec: Series 1095 Endura-Shield
- b) Sherwin Williams: Acrolon 218 HS
- c) Dry Film Thickness: 3.0 – 5.0

4) Finish Coat:

- a) Tnemec: Series 700 HydroFlon
- b) Sherwin Williams: FluoroKem HS
- c) Dry Film Thickness: 2.0 – 3.0

5) Total Dry Film Thickness: 13.0 – 19.0

Note (1) Series 66 may be interchanged with Series 161 when surface temperature is below 50 degrees (21degrees C) or when faster recoat is desired

Note (2) 66HS Epoxoline may be substituted for 66 Epoxoline.

9. Concrete Masonry Block & Concrete:

- a. Surface Preparation: SSPC SP13/NACE 6 Surface Preparation of Concrete. Surface shall be clean and dry.

1) First Coat:

- a) Tnemec: Series 130 Envirofill
- b) Sherwin Williams: Cement-Plex 875
- c) Carboline: Carboguard 510 Series (DFT: As required to fill the void or resurface the substrate. May be applied up to 2 inches per application. Feather-edging is not recommended.)
- d) Dry Film Thickness: 60 – 80 square feet per gallon

2) Second Coat:

- a) Tnemec: Series 156 Enviro-Crete
- b) Sherwin Williams: Conflex XL Smooth
- c) Carboline: Flexxide Elastomer
- d) Dry Film Thickness: 6.0 – 8.0 mils (Carboline: 6.0 mils)

3) Third Coat:

- a) Tnemec: Series 156 Enviro-Crete
- b) Sherwin Williams: Conflex XL Smooth
- c) Carboline: Flexxide Elastomer
- d) Dry Film Thickness: 6.0 – 8.0 mils (Carboline: 6.0 mils)

- 4) Total Dry Film Thickness: 12.7 - 17.5 mils
- 10. Pre-Cast, Poured-in-Place, & Tilt Up Concrete
 - a. First Coat:
 - 1) Carboline: Flexxide Elastomer
 - 2) Dry Film Thickness: 6.0 mils per coat
 - b. Finish Coat
 - 1) Carboline: Flexxide Elastomer
 - 2) Dry Film Thickness: 6.0 mils per coat
- 11. Wood
 - a. Surface Preparation: Clean and dry.
 - 1) First Coat:
 - a) Tnemec: Series 1099W Tnemec Primer
 - b) Sherwin Williams: PrepRite ProBlock Interior/Exterior Latex Primer/Sealer
 - c) Carboline: (Opaque) Sanitile 120
 - d) Dry Film Thickness: 2.0 – 3.0 mils (Carboline: 1.0 - 2.0)
 - 2) Second Coat:
 - a) Tnemec: Series 1029 Enduratone
 - b) Sherwin Williams: SherCryl HPA
 - c) Carboline: (Opaque) Carbocoat 8215
 - d) Dry Film Thickness: 2.0 – 3.0 mils
 - 3) Third Coat:
 - a) Tnemec: Series 1029 Enduratone
 - b) Sherwin Williams: SherCryl HPA
 - c) Carboline: (Opaque) Carbocoat 8215
 - d) Dry Film Thickness: 2.0 – 3.0 mils
 - 4) Total Dry Film Thickness: 6.0 – 9.0 mils

C. IMMERSION OR VAPOR ZONE SERVICE

- 1. Ferrous Metals Submerged or Intermittently Submerged in Wastewater (Closed Top / Head Space Exposure in Digesters, Secondary Clarifiers, etc.):
 - a. Surface Preparation: SSPC SP10 Near White Blast Cleaning
 - 1) Primer/Shop Coat:

- a) Tnemec: Series 20-1255 or 20HS Pota-Pox (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - b) Sherwin Williams: Macropoxy 240 (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 4.0 – 6.0 mils (Carboline: 20.0 – 60.0 mils)
 - 2) Lining:
 - a) Tnemec: Series 435 Perma-Glaze
 - b) Sherwin Williams: Dura Plate 5900
 - c) Dry Film Thickness: 30.0 – 40.0
 - 3) Finish:
 - a) Carboline: Plasite 4550S
 - b) Dry Film Thickness: 20.0 – 60.0 mils
 - 4) Total Dry Film Thickness: 34.0 - 46.0 mils.
 - 5) Holiday Detection: All surfaces shall be tested for discontinuities (holidays) utilizing a Tinker & Razor AP/W High Voltage Holiday Detector in accordance with the instructions of Tnemec Technical Services. Holidays shall be repaired in accordance with the instructions of the manufacturer.
2. Ferrous Metals Submerged or Intermittently Submerged in Wastewater (Open Top /No Head Space Exposure in Digesters, Secondary Clarifiers, etc.)
- a. Surface Preparation: SSPC SP10 Near White Blast Cleaning
 - 1) Primer/Shop Coat:
 - a) Tnemec: Series 1 Omnithane (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - b) Sherwin Williams: Corothane 1 GalvaPac 1K or 2k Zinc Primer (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 2.5 – 3.5 mils (Carboline: 20.0 – 60.0 mils)
 - 2) Intermediate:
 - a) Tnemec: Series 20-39BL Pota-Pox
 - b) Sherwin Williams: Macropoxy 646 Fast Cure
 - c) Dry Film Thickness: 4.0 – 6.0
 - 3) Finish:
 - a) Tnemec: Series 142 Epoxoline
 - b) Sherwin Williams: Macropoxy 5500 LT
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 10.0 – 12.0 (Carboline: 20.0 – 60.0 mils)

- 4) Total Dry Film Thickness: 16.5 – 21.5 mils.
 - 5) Holiday Detection: Interior surfaces, following a minimum of 96 hours cure, shall be holiday detected in accordance with ASTM G 62 low voltage holiday detection. Holiday detector shall be a Tinker & Rasor Model M-1 or equal. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions. The Engineer shall be notified of time of testing so that he might be present to witness testing.
3. Concrete Submerged or Intermittently Submerged in Wastewater (Closed Top / Head Space Exposure in Digesters, Secondary Clarifiers, Lift Stations etc.):
 - a. Surface Preparation: Abrasive blast to remove all loose concrete, laitance, hardeners, curing compounds and to leave a profile (Reference SSPC-SP 13, ICRI CSP 5 – 6)
 - 1) Primer/Surfacer:
 - a) Tnemec: Series 218 MortarClad
 - b) Sherwin Williams: Dura-Plate 2300
 - c) Dry Film Thickness: 1/16” minimum to all surfaces
 - 2) Lining:
 - a) Tnemec: Series 434 Perma-Shield H2S
 - b) Sherwin Williams: Dura-Plate 5900
 - c) Dry Film thickness: 125.0 mils
 - 3) Finish:
 - a) Tnemec: Series 435 Perma-Glaze
 - b) Sherwin Williams: Dura-Plate 5900
 - c) Dry Film Thickness: 15.0 – 20.0
 - 4) Holiday Detection: All surfaces shall be tested for discontinuities (holidays) utilizing a Tinker & Rasor AP/W High Voltage Holiday Detector in accordance with the instructions of Tnemec Technical Services. Holidays shall be repaired in accordance with the instructions of the manufacturer.
4. Ductile Iron Pipe (Outside Diameter - OD) Submerged or Intermittently Submerged in Wastewater (Open Top /No Head Space Exposure in Digesters, Secondary Clarifiers, etc.)
 - a. Surface Preparation: Uniformly abrasive blast the entire exterior surface using angular abrasive to an NAPF 500-03-04: “External Pipe Surface Condition”. When viewed without magnification, the exterior surfaces shall be free of all visible dirt, dust, loose annealing oxide, loose mold coating, rust and other foreign matter.
 - 1) Primer/Shop Coat:

- a) Tnemec: Series N140-1211 Pota-Pox Plus (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - b) Sherwin Williams: Macropoxy 5500 LT (Shop primed surfaces shall be prepared in accordance with Section 3.2-H-2-b above)
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 6.0 – 8.0 mils (Carboline: 20.0 – 60.0 mils)
- 2) Intermediate:
- a) Tnemec; Series 20-39BL Pota-Pox
 - b) Sherwin Williams: Macropoxy 646 Fast Cure
 - c) Dry Film Thickness: 4.0 – 6.0
- 3) Finish:
- a) Tnemec: Series 142 Epoxoline
 - b) Sherwin Williams: Macropoxy 5500 LT
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 10.0 – 12.0 (Carboline: 20.0 – 60.0 mils)
- 4) Total Dry Film Thickness: 20.0 - 26.0 mils.
- 5) Holiday Detection: Interior surfaces, following a minimum of 96 hours cure, shall be holiday detected in accordance with ASTM G 62 low voltage holiday detection. Holiday detector shall be a Tinker & Rasor Model M-1 or equal. Areas found to have holidays shall be marked and repaired in accordance with the paint manufacturer's instructions. The Engineer shall be notified of time of testing so that he might be present to witness testing.
5. Ductile Iron Pipe (OD) Submerged or Intermittently Submerged in Wastewater (Closed Top / Head Space Exposure in Digesters, Secondary Clarifiers, Lift Stations, etc.):
- a. Surface Preparation: Uniformly abrasive blast the entire exterior surface using angular abrasive to an NAPF 500-03-04: "External Pipe Surface Condition". When viewed without magnification, the exterior surfaces shall be free of all visible dirt, dust, loose annealing oxide, loose mold coating, rust and other foreign matter.
- 1) Primer:
- a) Tnemec: Series N140-1211 Pota-Pox Plus
 - b) Sherwin Williams: Dura-Plate UHS Primer
 - c) Carboline: Plasite 4550S
 - d) Dry Film Thickness: 5.0 -7.0 mils (Carboline: 20.0 – 60.0 mils)
- 2) Coating:
- a) Tnemec: Series 431 Perma-Shield PL
 - b) Sherwin Williams: Dura-Plate UHS
 - c) Carboline: Plasite 4550S

- d) Dry Film Thickness: 25.0 – 35.0 (Carboline: 20.0 – 60.0 mils)
 - 3) Total Dry Film Thickness: 30.0 - 42.0 mils.
 - 4) Holiday Detection: All surfaces shall be tested for discontinuities (holidays) utilizing a Tinker & Razor AP/W High Voltage Holiday Detector in accordance with the instructions of Tnemec Technical Services. Holidays shall be repaired in accordance with the instructions of the manufacturer.
6. Concrete Subjected to High Levels of H₂S
- a. Filler/Surfacers:
 - 1) Carboline: Carboguard 891VOC
 - 2) Dry Film Thickness: 4.0 – 10.0 mils per coat
 - b. Finish:
 - 1) Carboline: Reactamine 760
 - 2) Total Dry Film Thickness: 20.0 – 125.0 mils

D. COLOR SYSTEM MATERIAL IDENTIFICATION

1. The color system shall be selected by the Owner. If the Owner does not have a preference, the following shall be used.

Wastewater	Color	Tnemec Color Number
Raw Water (WW)	Olive green	110G Clover
Primary Effluent (WW1)	Aqua	10GN Aqua Sky
Biological Effluent (WWA)	Aqua	10GN Aqua Sky
Secondary Effluent (WW2)	Aqua	10GN Aqua Sky
Sewage Plant Effluent (WWC)	Clay	07RD Terra Cotta
Reclaimed Water (EFW)	Light purple	16SF Rec Water Purple
Sludge (S, RAS, WAS)	Dark brown	84BR Weathered Bark
Grit (GR)	Gray	33GR Gray
Scum (SC)	Gray	33GR Gray
Process Drain or Drain (DP or DR)	Dark Gray	34GR Deep Space
Sewer (Sanitary or other)	Dark Gray	34GR Deep Space
Chemical		
Alum. Or Primary	Orange	04SF Safety Orange
Ammonia	White	00WH White
Carbon Slurry	Black	35GR Black

Caustic	Yellow with green band	02SF Safety Yellow
Chlorine (Gas and Solution)	Yellow	02SF Safety Yellow
Fluoride	Light blue with red band	25BL Fountainbleu
Lime Slurry	Light green	37GN Irish Spring
Ozone	Yellow with orange band	02SF Safety Yellow
Phosphate Compounds	Light green with red band	37GN Irish Spring
Polymers or Coagulant Aids	Orange with green band	04SF Safety Orange with 09SF Safety Green Band
Potassium Permanganate	Violet	14SF Safety Purple
Soda Ash	Light green with orange band	37GN Irish Spring
Sulfuric Acid	Yellow with red band	02SF Safety Yellow
Sulfur Dioxide	Light green with yellow band	37GN Irish Spring with 06SF Safety Red Band
Other		
Compressed Air	Dark green	91GN Balsm
Gas	Red	28RD Monterrey Tile
Other Lines	Light gray	32GR Light Gray
Hoists/Trolleys	Yellow	02SF Safety Yellow

END OF SECTION 09 96 00

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior and exterior signs.
- B. Related Sections:
 - 1. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
 - 2. Section 23 05 53 - Identification for HVAC Piping and Equipment.

1.2 REFERENCES

- A. 2010 ADA Standards in accordance with 216 and in compliance with 703 less requirements for Braille.
- B. Unified Facilities Criteria (UFC) Design: Sign Standards, UFC 3-120-01, 2014.
- C. International Building Code (IBC).
- D. National Fire Protection Association (NFPA) 101

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.
- C. Samples: Submit all signs with accurate size illustrating type, style, letter font, and colors specified; method of attachment.
- D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Municipality or State standard.
- B. Check spelling; review connection methods for assurance of longevity.
- C. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive attachment tape at ambient room temperatures.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

2.1 INTERIOR SIGNS

- A. Manufacturers:
 - 1. ACE Sign Systems, Inc.
 - 2. Advance Corporation
 - 3. APCO Graphics, Inc
 - 4. Clarke Systems
 - 5. Mohawk Sign Systems
 - 6. Stamprite Supersine
 - 7. Vomar Products, Inc.
 - 8. Or Equal
- B. Product Description: Interior signs shall be hard phenolic ES/MP plastic laminate or acrylic for tactile signage. The signage may not be removable or allow paper inserts; permanent fixtures only.

2.2 COMPONENTS

- A. Engraved Signs: Laminated colored plastic; lettering engraved through face to expose core color:

1. Face Color: Clear or Black
2. Core Color: White or Black
3. Total Thickness: 1/16 or 1/8 inch.
4. Height: 2 inches.
5. Edges: Square.
6. Character Font: Helvetica.

2.3 ACCESSORIES

- A. Mounting hardware or adhesive method shall be approved by engineer.

1. Mounting Hardware: Chrome screws.
2. Adhesive: Silastic adhesive for use on smooth, irregular, porous or vinyl covered surfaces. Hold in place until the silastic has fully cured.

2.4 EXTERIOR SIGNS

- A. Manufacturers:

1. ACE Sign Systems, Inc.
2. Advance Corporation
3. APCO Graphics, Inc
4. Clarke Systems
5. Stamprite Supersine
6. Vomar Products, Inc.
7. Vulcan Utility Signs
8. Or Equal

- B. Product Description: Exterior signs shall be aluminum 5052 extruded or ACM (Dibond) for tactile signage. Screen printed with color matched component inks for maximum outdoor durability. Reflective sheeting, Type II DOT with UV protection.

2.5 COMPONENTS

- A. Engraved Signs: Laminated colored plastic; lettering engraved through face to expose core color:

1. Face Color: White
2. Lettering Color: Black
3. Total Thickness: < .08 inch
4. Height: 4 inches.
5. Edges: rounded
6. Character Font: Helvetica.

2.6 ACCESSORIES

- A. Mounting hardware or adhesive method shall be approved by engineer.

1. Mounting Hardware: Stainless Steel 316 screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

3.2 INSTALLATION

- A. Install signs after doors and surfaces are finished, in locations scheduled.
- B. Center sign on door surface, level; Or position sign 4 inches from strike side of door; on door surface, level.

3.3 SCHEDULES

- A. Office Door Signs: Individual Helvetica letters, 1 inch high, white color, identifying room name indicated on drawing schedule.
- B. Service Room Signs: Plaque signs, 2 inches high, black face color, white core color, "EQUIPMENT ROOM", "HVAC ROOM", "SHOWER/LOCKER ROOM" and "ELECTRICAL ROOM"; at each respective room location.
- C. Rest Room Door Graphic: 6 inches high, "UNISEX" graphic image; black color, located on each rest room door.
- D. Exterior Building Signs: Minimum 2" lettering identifying the building name with utilities' seal included below the lettering.

END OF SECTION 10 14 00

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Solid-plastic toilet compartments and urinal screens.
- B. Related Sections:
 - 1. Division 9 Section – "Gypsum Board Assemblies" for concealed steel strap backing plates for blocking and bracing within metal stud walls for anchorage of compartment and screen components.
 - 2. Division 10 Section - "Toilet Accessories" for toilet tissue dispensers, grab bars, sanitary napkin disposal units, and similar accessories mounted to toilet compartments.

1.3 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Meeting Class B, minimum, when tested according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's current detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories. Include construction details indicating materials, dimensions of individual components and profiles, and finishes for partition panels.
- B. Shop Drawings: Submit for toilet compartments and urinal screens. Include plans, elevations, sections, details, and attachment details.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show overhead support or bracing locations.
 - 5. Indicate attachments to other work.

C. Samples:

1. For Initial Selection: Submit manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of unit indicated.
2. For Verification: Submit the following in manufacturer's standard sizes unless otherwise indicated:
 - a. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch square samples of same thickness and material indicated for Work.
 - b. Each type of hardware and accessory, if requested by Architect.

- D. Maintenance Data: Submit manufacturer's maintenance instruction for care and cleaning of partition panel surfaces to include in maintenance manuals. Indicate recommended cleaning products, methods and maintenance procedures. Include as part of Project Closeout documents.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain toilet compartments and screens, including hardware and accessories, from a single manufacturer and from a single source.
- B. Regulatory Requirements: Comply with applicable provisions of the following regulations and standards for toilet compartments and urinal screens designated as accessible.
1. Code of Federal Regulations (CFR), Americans with Disabilities Act (ADA), 2010 ADA Standards for Accessible Design.
 2. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments and urinal screens by field measurements before fabrication. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay work.
- B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with specified requirements provide products of one of the following:
1. Bradley Corporation.
 2. Columbia Partitions / Div. Partition Systems Incorporated of South Carolina.

3. General Partitions Mfg. Corp.
4. Hadrian, Inc.
5. Scranton Products, Inc.

2.2 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).
- C. Brass Castings: ASTM B 584.
- D. Brass Extrusions: ASTM B 455.
- E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- F. Stainless-Steel Castings: ASTM A 743/A 743M.
- G. Plastic Panels: Manufacturer's solid, high-density polyethylene (HDPE) resin compound molded under pressure into panels of homogeneous color and pattern throughout.

2.3 SOLID-PLASTIC TOILET COMPARTMENTS AND SCREENS

- A. Basis of Design: Scranton Products, Inc.; products as specified below.
 1. City Hall Building: Hiny Hiders Signature Engraving Collection (engraved raised panel design).
 2. Restroom Building: Hiny Hiders Partitions (standard flush panel design).
- B. Compartment and Screen Styles:
 1. Toilet-Enclosures: Overhead braced, floor anchored.
 2. Urinal-Screens: Wall hung.
- C. Door, Panel, Screen, and Pilaster Construction: Fabricated from specified solid polymer panel material.
 1. Thickness: 1-inch, minimum.
 2. Panel Face and Edges: Seamless face with beveled or rounded eased edges.
 3. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 4. Color and Pattern: As selected by Architect from manufacturer's full range selection; one color and pattern in each room will be selected.
- D. Engraved Door Panels: Manufacturer's engraved design simulating raised panels. Design shall be as selected by Architect from manufacturer's standard options.
- E. Pilaster Shoes: Manufacturer's standard design; polymer or stainless steel.

1. Polymer Material: Manufacturer's standard in color and pattern matching pilaster.
 2. Stainless Steel: Type 304 alloy stainless steel sheet meeting ASTM A 666 or ASTM A 167.
- F. Overhead-Bracing (Headrail): Manufacturer's standard continuous extruded aluminum headrail of anti-grip profile, with clear anodized finish.
1. Provide concealed anchorage where possible, with concealed anchorage blocks, and exposed ends neatly closed with either matching end cap and/or filler.
 2. Return to side and back/rear walls at ends of runs, and again to back/rear walls at any locations where partition layouts off-set.
- G. Brackets (Fittings): Manufacturer's heavy duty full-height continuous length; minimum 16 gauge (0.062-inch) thickness, type 304 stainless steel mounting brackets with pre-drilled holes for attachment of panels and pilasters; satin finish.
1. Provide channel, angle, and double-angle-channel types as required for application conditions.
 2. Limit exposed angle flanges to interior of stalls where possible, and where permanence of installation will not be reduced or otherwise affected.

2.4 HARDWARE AND ACCESSORIES

- A. Continuous Hinges: Manufacturer's full-length heavy duty, minimum 14 gauge (0.78-inch) type 304 stainless steel continuous hinge; self-closing multi-cam type; satin finish.
1. Hinges shall be designed for continuous anchorage of door panels to pilasters; pre-drilled to accept specified fasteners spaced at maximum 8-inches on center with first and last holes located not more than 2-inches from each end.
 2. Hinge cam shall pre-set door positions with out-swings to normal closed position and in-swings to partial open position.
- B. Latch, Strike and Keeper: Manufacturer's heavy-duty stainless-steel surface-mounted slide latch unit, minimum 14-gauge (0.78-inch) material thickness; satin finish.
1. Strikes shall be of design for emergency access with combination rubber-faced door strike and keeper.
 2. Provide units that comply with ADA requirements at compartments designated as accessible.
- C. Coat Hooks for Compartments:
1. Bumper and Coat Hook for In-Swinging Doors: Manufacturer's heavy-duty stainless steel, minimum 14-gauge (0.78-inch) material thickness, combination bumper and hook; satin finish with rubber bumper; sized to prevent door from hitting compartment-mounted accessories.
 2. Coat hook for out-swinging doors: Manufacturer's heavy-duty stainless-steel design; minimum 14-gauge (0.78-inch) material thickness, satin finish. Coat hook shall be mounted above finish floor at height complying with ADA requirements.

- D. Door Pull for Out-Swinging Doors: Manufacturer's heavy-duty stainless-steel design for mounting on door direct on opposite side of latch and complying with ADA requirements; minimum 14-gauge (0.78-inch) material thickness; satin finish. Provide pulls on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- E. Wall Bumper for Out-Swinging Doors: Wall-mounted heavy-duty stainless-steel type with rubber bumper; satin finish.
- F. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads.
 - 1. Provide sex-type bolts for through-bolt applications.
 - 2. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 FABRICATION

- A. Fabricate toilet compartment and urinal screen components to sizes indicated.
 - 1. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
 - 2. Verify door clearances with fixtures and coordinate clearances with toilet accessories.
- B. Overhead-Braced, Floor-Anchored Partitions: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
 - 1. Make provisions for setting and securing continuous head rail at top of each pilaster.
 - 2. Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters for connection to floor.
 - 3. Fabricate pilaster shoes to conceal anchorage and leveling mechanism.
- C. Urinal-Screens: Fabricate panels for wall hung installation with specified continuous brackets.
- D. Door Sizes and Swings: Unless otherwise indicated, provide toilet compartments with the following door sizes and swings as specified.
 - 1. Standard Compartments: 24-inch width, in-swinging doors.
 - 2. Accessible Compartments: 36-inch width, out-swinging doors; providing not less than 32-inch wide clear opening when installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
- B. Confirm location and adequacy of blocking and supports required for installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Clearances for Panels, Doors and Pilasters:
 - a. Between Panel and Pilaster: 1/2-inch maximum, except where concealed fasteners are used.
 - b. Between Door Edge and Pilaster: 1/4 inch, maximum.
 - c. Between Panel and Wall: 3/4-inch maximum
 - 2. Full-Height (Continuous) Bracket Installation: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - c. Attach brackets rigid in place with tamper-resistant fasteners.
- B. Overhead-Braced, Floor-Anchored Units:
 - 1. Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions.
 - 2. Secure continuous head rail to each pilaster with not less than two fasteners.
 - 3. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
 - 4. Brackets: Secure panels to walls and to pilasters with continuous full length brackets as specified.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation.
 - 1. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched.
 - 2. Set hinges on out-swinging doors to return doors to fully closed position.

- B. Cleaning: Clean exposed surfaces of toilet compartment and urinal screens, including hardware, by washing using neutral detergent and water. Rinse washed surfaces with clean water and wipe dry with soft, absorbent lint-free cloths.
- C. Protection: Provide final protection and maintain conditions that ensure toilet compartments and urinal screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 21 13

SECTION 10 22 26 - OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Operable acoustical panel partitions.
- B. Related Sections:
 - 1. Division 5 Section - "Metal Fabrications."
 - 2. Division 9 Section – "Gypsum Board Assemblies."

1.2 SUBMITTALS

- A. Product Data: Indicate partition type and construction, operation, acoustical properties, fire performance, finishes, suspension system, hardware and accessories. Include installation instructions.
- B. Shop Drawings: Include plans, elevations and large scale details of operable partitions. Indicate partition construction, locations and layout, dimensions, panel materials and finishes, seals, suspension system and stacking arrangement.
 - 1. Include fabrication and installation details, anchorages and relationship to adjacent work.
 - 2. Indicate spacing of track support brackets, spacing of hanger rods and allowable deflection of track assembly.
- C. Certification: Submit certified test reports from an independent testing laboratory accredited by the U.S. Bureau of Standards indicating that operable partitions meet specified acoustical performance and fire performance classification requirements.

1.3 QUALITY ASSURANCE

- A. Installer qualifications: Installer shall have been trained by operable partition manufacturer with minimum Ten (10) years experience in the satisfactory installation of operable partition systems similar in nature and scope as required for this project. If requested by Architect, submit evidence of training and satisfactory installations of similar work within period specified.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original factory wrappings and containers with manufacturer's labels intact identifying product name, quality or grade, fire performance characteristics and lot number.

- B. Store materials in original undamaged packages or containers, indoors in a well-ventilated area, protected from the weather, extreme temperature and humidity conditions, moisture and soiling. Store panels on edge, blocked off floor to prevent sagging and warping.

1.5 PROJECT CONDITIONS

- A. Field measurements: Take field measurements to determine dimensions and sizes for panel fabrication to ensure for proper fit. Indicate field measurements on shop drawings.
- B. Sequencing and scheduling: Coordinate location and installation of structural supports for partition system including construction of sound barriers above ceilings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with specified requirements:

1. Holcomb & Hoke Manufacturing Co., Inc.
2. Hufcor, Inc.
3. Modernfold, Inc.
4. Panelfold, Inc.

2.2 OPERABLE PARTITIONS

- A. Basis of Design: Hufcor, Inc.; Series 642.
 1. Operable partitions of similar design and construction by other acceptable manufacturers may be submitted for Architect's acceptance.
 2. Acceptance is subject to compliance with specified requirements as evidenced by submittal of product data and certified laboratory test reports.
- B. Partition Type: Top-supported paired panels; stacking arrangement as indicated on drawings.
- C. Panel Construction: Manufacturer's standard steel construction; minimum 22-gauge (0.0299-inch thickness) roll formed steel faces with acoustical backing material assembled to minimum 16-gauge (0.0598-inch thickness) reinforced welded steel frame and insulated to achieve acoustical performance specified. Top of panels shall be reinforced to support suspension system components.
 1. Panel Thickness: 4-inches, nominal.
 2. Panel Weight: Maximum 9.5-psf as determined by panel construction, size and finish.
 3. Vertical Edge Trim: Concealed edge trim with interlocking astragal incorporating continuous vinyl acoustical seals.
- D. Panel Finish:

1. Material: Manufacturer's standard factory-applied acoustical needle punch carpet.
 2. Color: As selected by Architect from manufacturer's standard selection.
- E. Acoustical Performance: Operable partition system shall be constructed to provide Sound Transmission Class (STC) rating of minimum 52 as determined by ASTM E 413 when laboratory tested in accordance with ASTM E 90 in a full scale 14-ft. (168-inches) by 9-ft. (108-inches) opening with all seals active and without pass doors.
- F. Fire Performance Classification: Finish materials and panel construction meeting Class A, maximum 25 flame spread rating and maximum 450 smoke development, when tested in accordance with ASTM E 84, UL 723 or NFPA 255.
- G. Panel Seals:
1. Horizontal Seals:
 - a. Top Seals: Continuous contact extruded vinyl or mechanical retractable compression type seals exerting positive pressure on track when extended.
 - b. Floor Seals: Automatic or mechanical retractable compression type. Floor seals shall provide minimum 1" clearance when retracted. Seal shall secure panel in place, providing lateral stability and exerting positive pressure downward to assure sealing.
 2. Vertical Edge Seals: Manufacturer's standard continuous vinyl compression type seals incorporated into astragals for interlocking with adjacent panels.
 3. Lead Panel Seal: Compressible bulb-seal type without use of wall jamb.
 4. Final Closure: Positive bulb-seal type adjustable mechanical closure. Hinged closure shall not be acceptable.
- H. Suspension System:
1. Top track: Manufacturer's standard heavy duty extruded aluminum or steel track of design to support loads imposed. Track deflection independent of structural support system shall not exceed L/360 of opening width. Provide support brackets with adjustable threaded rods of sizes recommended by manufacturer and indicated on approved shop drawing for attachment of track to structural supports. Furnish track in longest lengths practicable.
 2. Trolleys: Ball bearing type trolley assemblies of capacity to carry loads imposed. Trolleys shall be attached to panels with adjustable steel pendant bolts. Wheel assemblies shall have provisions for lubrication.
- I. Hinges: Manufacturer's standard hinges.
- J. Pocket Doors: Full height at end of partition runs to conceal stacked partitions as indicated; same design, appearance and acoustical characteristics as partition panels.
1. Doors shall be hinged to jamb on each side and closing in the center. One of the door panels shall be equipped with a smaller hinged panel that folds back when the operable partition is extended into the pocket.

2. Provide complete with adjustable frames, full perimeter acoustical seals and operating hardware.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine floor surfaces overhead structural supports and adjacent construction prior to operable partition installation. Verify compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions.
- B. Verify that floor surfaces direct under operable partition location is smooth and level within plus or minus 1/16-inch variation. Confirm that jamb surfaces in which partition panels will contact is plumb within 1/4-inch in 10-ft. (10'-0"), noncumulative.
- C. Notify Architect of any conditions detrimental to proper installation of operable partition system. Make corrections to defective or unsatisfactory conditions as required.
- D. Do not proceed with installation until defective or unsatisfactory conditions have been corrected and is acceptable to installer.

3.2 INSTALLATION

- A. Install operable partition system at locations indicated in accordance with manufacturer's product data and approved shop drawings. Comply with ASTM E557-00(2006)e1 for installation practices.
- B. Attach top track assembly to support brackets connected to overhead structural supports.
 1. Install track aligned and level at proper locations with joints occurring over support brackets; use bolted splice plates and alignment plates at all joints.
 2. Space brackets supporting track to limit deflection within criteria specified in installation standard when loaded, unless more stringent requirements are required by partition manufacturer.
- C. Install panels to track assembly, plumb and level. Make adjustments as required to permit proper fit, alignment and operation.
- D. Verify operation of panels upon completion of installation. Partition system shall operate smooth without binding or sticking at track and without rubbing floor surface with bottom seals of panels retracted.

3.3 ADJUSTING, CLEANING AND PROTECTION

- A. Lubricate and adjust operating mechanisms in accordance with manufacturer's instructions upon completion of installation to provide for smooth and easy operation.

- B. Adjust panel seals as required to provide positive seal to maintain effective sound barrier. Ensure that bottom seals when extended makes full contact with floor surface for an airtight closure.
- C. Protect finished surfaces from damage, soiling or staining. Replace or repair damaged partitions. Repair work shall be acceptable to Architect and indistinguishable in the finished installation.
- D. Clean partition surfaces just prior to Date of Substantial Completion. Avoid use of abrasive cleaners or solutions containing corrosive solvents; use cleaning materials as recommended by manufacturer.

3.4 DEMONSTRATION

- A. Just prior to Date of Substantial Completion, instruct Owner's personnel in the proper operation, maintenance and care of operable partition system.
- B. Demonstrate and review procedures for setting up and storing partitions.
 - 1. Check operation of partition components with Owner's personnel present.
 - 2. Make final adjustments as required to ensure for proper function.

END OF SECTION 10 22 26

SECTION 10 28 13 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Toilet room accessories. The extent of toilet and other accessory items are indicated on the Drawings, and include the following:
 - 1. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Warm-air dryers.
 - 4. Childcare accessories.
 - 5. Underlavatory guards.
 - 6. Custodial accessories.
- B. Related Sections:
 - 1. Division 4 Section – "Unit Masonry."
 - 2. Division 9 Section – "Gypsum Board Assemblies."
 - 3. Division 10 Section - "Toilet Compartments."

1.3 SUBMITTALS

- A. Product Data: Submit for each toilet accessory item specified, including details of construction relative to materials, dimensions, gauges, profiles, method of mounting, specified options, and finishes.
- B. Product Schedule: Indicate types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using same designations indicated on Drawings.
- C. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.
- D. Maintenance Data: Submit toilet accessories manufacturers to include in maintenance manuals. Submit as part of contract closeout documents.

1.4 QUALITY ASSURANCE

- A. Single-Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.
- B. Regulatory Requirements: Comply with applicable provisions of the following regulations and standards for toilet and shower accessories installed at locations designated as accessible.
 - 1. Code of Federal Regulations (CFR), Americans with Disabilities Act (ADA), 2010 ADA Standards for Accessible Design.
 - 2. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities."
- C. Product Certification: Electric hand dryers shall be ETL listed by Intertek Group, plc or UL listed by Underwriters Laboratories, Inc. in conformance with UL 507 standard.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

1.5 COORDINATION

- A. Toilet Accessories: Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.
- B. Grab Bar Anchor Plates: Coordinate installation of concealed anchor plates with drywall and masonry wall construction for mounting of grab bars.
- C. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

1.6 WARRANTIES

- A. Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within warranty period of not less than Fifteen (15) years from date of Substantial Completion.
- B. Hand Dryer Warranty: Manufacturer's standard form covering defects in materials and workmanship under normal use. Manufacturer agrees to replace or repair defective parts within warranty period of not less than Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers; subject to compliance with specified requirements:
 - 1. American Specialties, Inc. (ASI).

2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.

2.2 BASIC MATERIALS AND FINISHES

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gauge (.034-inch) minimum thickness, unless otherwise indicated.
- B. Brass: Leaded and unleaded, flat products, ASTM B 19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16, Castings, ASTM B-30.
- C. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 20-gauge (.040-inch) minimum, unless otherwise indicated. Surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 527, G60.
- E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
- F. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.
- H. Keys: Unless otherwise indicated, provide universal keys for access to toilet accessory units requiring internal access for servicing and resupply. Provide minimum of 6-keys to Owner's representative and obtain receipt.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Toilet Tissue Dispenser (Standard Roll): TA01.
 1. Basis-of-Design Product: Bobrick B-2840.
 2. Description: Double-roll dispenser with utility shelf.
 - a. Mounting: Surface mounted.
 - b. Operation: Non-control delivery with theft-resistant spindle.
 - c. Capacity: Up to 5 1/2-inch diameter tissue rolls.
 - d. Material and Finish: Stainless steel, No. 4 satin finish, with high impact, black, polystyrene spindles.
- B. Soap Dispenser, Foam Type, Manual: TA16.
 1. Basis-of-Design Product: Sloan SJS-1100.
 2. Description: Automatic Foam Soap Dispenser.
 - a. Mounting: Wall mount, surface.
 - b. Capacity: 34 fl. oz.

- c. Materials: Polished Chrome Plated Plastic.
- d. Refill Indicator: Window type.
- e. Accessories: Provide 2 refill bags for each unit.

C. Grab Bar (short): TA20..

- 1. Basis-of-Design Product: Bobrick B-6806 × 18.
- 2. Mounting: Flanges with concealed fasteners.
- 3. Material and Finish:
 - a. Material: Stainless steel, 0.05 inch thick.
 - b. Finish: Smooth, No. 4 satin finish on ends and slip-resistant texture in grip area.
- 4. Outside Diameter: 1-1/2 inches.
- 5. Configuration and Length: Straight, 18 inches long.

D. Grab Bar (medium): TA21.

- 1. Basis-of-Design Product: Bobrick B-6806 × 36.
- 2. Mounting: Flanges with concealed fasteners.
- 3. Material and Finish:
 - a. Material: Stainless steel, 0.05 inch thick.
 - b. Finish: Smooth, No. 4 satin finish on ends and slip-resistant texture in grip area.
- 4. Outside Diameter: 1-1/2 inches.
- 5. Configuration and Length: Straight, 36 inches long.

E. Grab Bar (long): TA22.

- 1. Basis-of-Design Product: Bobrick B-6806 × 42.
- 2. Mounting: Flanges with concealed fasteners.
- 3. Material and Finish:
 - a. Material: Stainless steel, 0.05 inch thick.
 - b. Finish: Smooth, No. 4 satin finish on ends and slip-resistant texture in grip area.
- 4. Outside Diameter: 1-1/2 inches.
- 5. Configuration and Length: Straight, 42 inches long.

F. Mirror, Framed, without Shelf: TA23.

- 1. Basis-of-Design Product: Bobrick B-165-2436.
- 2. Frame: Stainless steel channel.
- 3. Corners: Mitered, welded, and ground smooth.
- 4. Hangers: Produce rigid, tamper and theft-resistant installation, using one-piece, galvanized steel, wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- 5. Size: 24 inches wide × 36 inches high.

G. Sanitary Napkin Disposal Unit, Surface-mount: TA29.

1. Basis-of-Design Product: Bobrick B-254.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing disposal opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4.

2.4 PUBLIC USE SHOWER ROOM ACCESSORIES

A. Shower Seat, Folding-Type: TA36.

1. Basis-of-Design Product: Bobrick B-5181.
2. Description: Fold-up, reversible shower seat complete with mounting kits, anchor, and accessories, as required to support 360 lbs. in compliance with accessible design guidelines.
3. Configuration: L-shaped seat, designed for wheelchair access.
4. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
5. Mounting Mechanism: Stainless steel, No. 4 satin finish.
6. Width: 33 inches.

B. Shower Curtain Rod, Extra-Heavy-Duty (straight): TA 41.

1. Basis-of-Design Product: Bobrick B-6047.
2. Description: 1-1/4 inch OD; fabricated from nominal 0.0375-inch-thick stainless steel.
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Finish: Stainless steel, No. 4 satin finish.

2.5 WARM AIR DRYERS

A. Warm Air Dryer: TA50.

1. Basis-of-Design Product: Bobrick B-7128-115V.
2. Mounting: Surface mounted.
3. Operation: Electronic sensor activated with timed power cut-off switch.
4. Operation Time: 30 to 40 seconds.
5. Cover Material and Finish: Stainless steel, No. 4 satin finish.

2.6 CHILDCARE ACCESSORIES

A. Diaper-Changing Station: TA55.

1. Basis-of-Design Product: Koala KB110-SSWM.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

- a. Engineered to support a minimum of 250-lb static load when opened.
- b. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
- c. Operation: By pneumatic shock-absorbing mechanism.
- d. Material and Finish: Stainless steel, No. 4 satin finish.
- e. Liner Dispenser: Built in.

2.7 UNDERLAVATORY GUARDS

A. Underlavatory Guard: TA58.

1. Basis-of-Design Product: Plumberex Soft Guard Plus.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.8 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder: TA60.

1. Basis-of-Design Product: Bobrick B-224 × 36.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Three.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 satin finish.
 - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
 - b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.9 FABRICATION

- A. Manufacturer's Identification: Only a maximum 1-1/2-inch diameter, unobtrusive stamped logo of manufacturer, as approved by Architect, is permitted on an inconspicuous face of toilet or bath accessory units. Identification mark shall be located on either interior surface not exposed to view or back surface, provide additional identification by means of either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- C. Recessed Toilet Accessories: Fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

- D. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six (6) keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install toilet accessory units according to manufacturers' current written instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit.
- B. Use concealed fastening methods for attachment of accessories unless otherwise specified by product types employing exposed fastener installations.
- C. Install units plumb and level, firmly anchored in locations and at heights indicated.
- D. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.
1. Anchor grab bar to metal stud partitions using manufacturer's minimum 12-gauge (0.109-inch) thickness by 3-inches width steel anchor plates tapped to receive machine screws. Anchor plates shall be of continuous length required to facilitate attachment of grab bars, spanning between studs.
 - a. Attach anchor plates to studs at grab bar mounting heights, using self-tapping sheet metal screws or by welding.
 - b. Where grab bar mounting flanges require attachment at different walls or at vertical or angled positions, provide anchor plates of lengths to span between studs at each flange location.
 - c. Secure grab bars to anchor plates using 1/4-inch diameter stainless steel machine screws.
 2. Mount grab bars to masonry and concrete walls using 1/4-inch diameter stainless steel machine screws and expansions shields.
- E. Make electrical connections to hand dryers complying with requirements specified in Division 26-Electrical sections.

3.2 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings and films prior to cleaning.
- C. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Portable Fire extinguishers.
- 2. Fire extinguisher cabinets, factory finished.

B. Related work specified elsewhere includes:

- 1. Division 1 Section – "Temporary Facilities."
- 2. Division 6 Section – "Rough Carpentry".
- 3. Division 9 Section – "Gypsum Board Assemblies."
- 4. Division 9 Section – "Painting."

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: Indicate extinguisher and cabinet sizes, mounting heights and method of installation. Include cabinet installation details.
- C. Finish Samples: Where color selections by Architect are required, include color charts showing full range of manufacturer's standard colors and designs available.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility:

- 1. Obtain fire extinguishers through one source and from a single manufacturer.

2. Obtain fire extinguishers, cabinets, and brackets from a single manufacturer and from one source.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguisher Listing and Labels: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.
- D. Inspection Service:
 1. Fire extinguishers shall include an inspection certification tag attached, indicating date of charge, servicing agent's name and address. Charge date shall have not been more than sixty (60) days prior to Date of Substantial Completion.
 2. Servicing agent shall be located within 50 miles of the Project.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

- A. Acceptable Manufacturers; subject to compliance with requirements, provide products by one of the following:
 1. Amerex Corp.
 2. Fire End & Croker Corporation.
 3. J.L. Industries / Activar Corporation Products, Inc.
 4. Larsen's Manufacturing Company.
 5. Modern Metal Products/Div. Technico, Inc.
 6. Potter Roemer - Fire Pro / Div. Morris Group International.
- B. Multi-Purpose Dry-Chemical Type: Meeting UL 299 standard.
 1. Classification: Classified for use on Class A, B and C fires.
 2. Rating: UL-rated 4-A:80-B:C.
 3. Capacity: 10-lbs. nominal capacity.
 4. Container: Manufacturer's standard heavy duty steel cylinder with impact resistant polyester/epoxy paint finish.
 5. Operation: Pull-pin with squeeze grip handle operation for variable controlled release.
 6. Accessories: Equip with pressure gauge, hose and nozzle.

2.2 FIRE EXTINGUISHER CABINETS

- A. Acceptable Products; subject to compliance with specified requirements:
 1. Fire End & Croker Corporation; 1600 Series.

2. J.L. Industries, Inc.; Ambassador Series.
3. Larsen's Manufacturing Company; Architectural Series.
4. Modern Metal Products/Div. Technico, Inc.; 100 Series.
5. Potter Roemer - Fire Pro / Div. Morris Group International.; Alta 7000 Series.

B. Type: Semi-recessed cabinet.

1. Door:
 - a. Style: Duo-vertical panel.
 - b. Material and Construction: Minimum 20-gauge (0.0359-inch) thickness cold-rolled steel; rolled-formed, one-piece tubular construction.
 - c. Finish: Manufacturer's baked enamel coating acceptable for field painting.
 - d. Glazing: Provide clear transparent acrylic sheet for duo-vertical panel door style.
2. Trim:
 - a. Style: Rolled-edge; 2-1/2-inch backbend depth.
 - b. Material and Construction: Minimum 20-gauge (0.0359-inch) thickness, cold-rolled steel; rolled-formed, one-piece tubular construction.
 - c. Finish: Same as specified for door.
3. Cabinet Case: Minimum 20-gauge (0.0359-inch) thickness cold-rolled steel, one-piece formed construction; factory finished in manufacturer's standard white baked enamel coating.
4. Cabinet Size: Nominal 24-inch height by 10-inch width by 6-inch depth for full semi-recessed installation to 4-inch depth.
5. Hardware:
 - a. Hinge: Manufacturer's full length continuous hinge of same material and finish as trim, capable of 180-degrees swing.
 - b. Door Pull and Catch: Manufacturer's standard pull handle with roller catch.
 - c. Door Lock: Manufacturer's keyed, vandal-resistant, cam lock that allows door to be opened during emergency by pulling sharply on door handle. Provide with all locks for cabinets keyed alike.

2.3 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard wall mounted steel bracket designed to support extinguishers secured in vertical position on wall or centered in cabinets. Provide in sizes and capacities required for specified extinguishers with plated or baked enamel finish.
- B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
 1. Extinguisher Cabinets: Provide die-cut vinyl, self-adhering, pre-spaced lettering reading "FIRE EXTINGUISHER", in size and color as selected by Architect; vertical orientation. Supply lettering loose for application following field painting of cabinets.

2. Bracket-Mounted Extinguishers: Identify with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for cabinets to verify actual locations and dimensions of rough openings before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets are to be installed.
- C. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
- C. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
- D. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
 1. Anchor to wall construction using minimum two anchors each; located top and bottom, interior of cabinet and concealed when doors are closed.
 2. Anchors shall be of type and size recommended by cabinet manufacturer for substrates encountered, with exposed heads finished to match cabinet interior.
- E. Install fire extinguisher cabinets and mounting brackets at heights as follows:
 1. Fire Extinguisher Cabinets: 4'-0" A.F.F. to horizontal centerline of door handle.
 2. Fire Extinguisher Mounting Brackets: 4'-0" A.F.F. to horizontal centerline of bracket release mechanism.
- F. Comply with the requirements of NFPA 10 for location of fire extinguishers and to authorities having jurisdiction, if not otherwise shown on drawings. Where exact location of cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by Architect.

- G. Install multi-purpose dry-chemical type extinguishers to cabinets located throughout facility and at other locations bracket mounted to wall construction.
- H. Install portable fire extinguishers to locations at Date of Substantial Completion. Each extinguisher shall be attached with an inspection certification tag indicating acceptable charge pressure, date of charge and servicing agent.

END OF SECTION 10 44 00

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Division 8 – Openings
 - 2. Section 13 34 19- Metal Building Systems

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections
- B. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher, cabinet and mounting brackets.
- C. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
- D. Warranty: Sample of special warranty.
- E. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Larsens Manufacturing Company.
 - d. Potter Roemer LLC.
 - e. Or Approved Equal.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Brass Container: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated-brass container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amerex Corporation.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Larsens Manufacturing Company.
 - d. Potter Roemer LLC.
 - e. Or Approved Equal.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical or Horizontal.

2.4 FIRE EXTINGUISHER CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amerex Corporation.
 2. JL Industries, Inc.; a division of the Activar Construction Products Group.
 3. Larsens Manufacturing Company.
 4. Potter Roemer LLC.
 5. Or Approved Equal.
- B. General: Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.
- C. All steel with factory pre-finished white baked acrylic enamel paint and flush Vertical Duo style door glazed with colorless transparent tempered glass.
1. Identify fire extinguisher in cabinet with vertical die-cut red lettering reading "Fire Extinguisher," applied to door. Letter style, size, spacing, and location shall be as selected by Engineer from manufacturer's standard arrangements provided with submittals.
- D. Verify semi-recessed design with Owner prior to ordering. Provide equivalent surface-mounted cabinet when requested by Owner.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 13 31 22 – PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes complete single-story, rigid-frame-type, clear span, insulated, pre-engineered metal building systems of the nominal length, width, eave height, and roof pitch, with straight columns, and as indicated on the Drawings.
 - 1. Roof System consists of the manufacturer's standard lap panel roof and related work.
 - 2. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.
- B. Metal siding, perforated soffits, and additional and related items and work shall be provided at locations where indicated on the Drawings.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
 - 1. Section 033000 – Cast-in-Place Concrete
 - 2. Section 055000 – Metal Fabrication
 - 3. Section 05120 – Structural Steel
 - 4. Section 079200 – Joint Sealers
 - 5. Section 099600 – Painting

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Engineer, design, fabricate and erect the pre-engineered metal building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
 - 1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
 - 2. Provide grounding system for lightning protection; Comply with building manufacturer's recommendations.
- B. Design Loads: Basic design loads, as well as auxiliary and collateral loads, are indicated on the drawings, and shall in addition be as required by project conditions.
 - 1. Basic design loads include live load, and wind load, in addition to the dead load.
 - 2. Collateral loads shall include additional dead loads over and above the weight of the metal building system, such as roof-mounted and suspended mechanical systems, finished ceilings, light fixtures, conduits, ductwork, piping, equipment, overhead doors, etc.

3. All frames shall be designed to limit lateral drift per Drawings

C. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual," in accordance with notes and requirements on Structural Drawings, and the following. Where a conflict in requirements may occur, the more stringent requirements shall apply. Comply with requirements for U.L. Class 90 wind uplift rating.

1. AISC "Code of Standard Practice for Steel Buildings and Bridges":

a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."

2. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses, including the "Commentary" and Supplements thereto, as issued.

3. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.

4. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures, and AWS D1.1 "Structural Welding Code."

5. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

6. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product data consisting of metal building system manufacturer's product information for building components and accessories.

C. Shop drawings prepared by or under the supervision of a registered Professional Engineer, for metal building structural framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data. The responsible design engineer shall place his stamp on all Shop Drawings.

1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a professional engineer legally authorized to practice in the jurisdiction where the Project is located and where the system components are manufactured. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing. Include transverse cross-sections. Design analysis shall be included,

to show all design loads, load combinations, foundation reactions and lateral deflections.

2. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
 3. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation.
- D. Professional engineer's certificate prepared and signed by the responsible design Engineer, legally authorized to practice in the jurisdiction where Project is located and where the system components are manufactured, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project for at least 5 verifiable years, and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.
- B. Manufacturer's Qualifications: Provide pre-engineered metal buildings manufactured by a firm with no less than 5-years verifiable experience in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.
- C. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures". Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests within previous 12-months. If recertification of welders is required, retesting will be CONTRACTOR'S responsibility.
- D. Single-Source Responsibility: Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.
- E. Design Criteria: The drawings indicate size, profiles, and dimensional requirements of the pre-engineered metal buildings and are based on the specific type and model indicated. Metal building systems having equal characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept or intended performance as judged by the ENGINEER. The burden of proof of equality is on the proposer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.
- B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to not delay that work.
- C. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

- D. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weather tight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.
- E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 WARRANTY AND GUARANTEE

- A. Roofing and Siding Panel Warranty: Furnish the roofing and siding panel manufacturer's written warranty, covering failure of the metal wall and roof panels within the warranty period.
 - 1. Warranty Periods (from date of Substantial Completion)
 - a. Weather-tightness: 20-years.
 - b. Finishes: 20-years.
 - c. Materials and Workmanship: 3-years.
- B. This warranty and guarantee shall be in addition to and not a limitation of other rights the Owner may have under the Contract Documents, and shall run concurrently with other project warranties and guarantees.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with specified requirements, provide metal building systems provided by one of the following:
 - 1. American Buildings Co.
 - 2. Atlantic Building Systems.
 - 3. Butler Manufacturing Co.
 - 4. Ceco Buildings Division.
 - 5. Gulf States Manufacturers, Inc.
 - 6. Metal Building Components, Inc.
 - 7. O.S.I., Inc.
 - 8. Star Buildings Division, H. H. Robertson Co.
 - 9. Varco-Pruden Buildings.
 - 10. Approved Equal

2.2 MATERIALS

- A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 572 or A 529.
- B. Steel Tubing or Pipe: Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.
- C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.

- D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 607, Grade 50.
- E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 or ASTM A 568.
- F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 or ASTM A 569.
- G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 coating complying with ASTM A 525. Grade to suit manufacturer's standards.
- H. Aluminum-Zinc Alloy Coated Steel Sheets ("Galvalume"): Comply with ASTM A 428, latest edition.
- I. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.
- J. Anchor Bolts: ASTM A 307, non-headed type unless otherwise indicated.
- K. Non-Metallic Shrinkage-Resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C621.
 - 1. Products offered by manufacturers to comply with requirements for non-metallic, non-shrink grout include the following:
 - a. Euco N.S.; Euclid Chemical Company
 - b. Crystex; L&M Construction Chemicals
 - c. Masterflow 713; Master Builders
 - d. Five Star Grout; U.S. Grout Corp.
 - e. Upcon; Upco Chemical Division, USM Crop.
 - f. Propak; Protex Industries, Inc.
- L. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with compositional requirements of federal specifications indicated is not required.
 - 1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, abrasion-resistant, rust-inhibitive primer selected by the manufacturer for compatibility with substrates with types of alkyd finish paint systems indicated and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-86, Types I, II, or III.
 - 2. Shop Primer for Galvanized Metal Surfaces: Zinc dust-zinc oxide primer selected by the manufacturer for compatibility with substrate. Comply with FS TT-P-641.

2.3 STRUCTURAL FRAMING

- A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam" -shape or open-web-type frames consisting of tapered or parallel flange beams and straight columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.

1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer's standards, and proposed in writing by manufacturer and accepted in writing by ENGINEER prior to Bid Date.
 2. Building eave height: 10 Feet as measured from concrete slab
 3. Roof Pitch: 1/12
 4. Provide rigid frames at endwalls where indicated.
- B. Primary Endwall Framing: Provide the following primary endwall framing members fabricated for field-bolted assembly:
1. Endwall Columns: Manufacturer's standard shop-painted, built-up factory-welded "I"-shape or cold-formed "C" sections, fabricated from 14-gage (0.0747-inch) steel.
 2. Endwall Beams: Manufacturer's standard shop-painted "C"-shape roll-formed sections fabricated from 16-gage (0.0598-inch) steel.
- C. Secondary Framing: Provide the following secondary framing members:
1. Roof Purlins, Sidewall and Endwall Girts: "C"-or "Z"-shaped sections fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
 2. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from 16-gage (0.0598-inch) shop-painted roll-formed steel.
 3. Flange and Sag Bracing: 1-5/8-inches by 1-5/8-inch angles fabricated from 16-gage (0.0598-inch) shop-painted roll-formed steel, unless indicated otherwise on Structural Drawings.
 4. Base or Sill Channels: Fabricate from 14-gage (0.0747-inch) cold-formed galvanized steel sections.
- D. Wind Bracing: All bays and end walls are to remain open. If wind bracing is required, the manufacturer may use either heavier structural members or portal frames.
- E. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.

2.4 SHOP PAINTING

- A. General: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning, unless specific procedures are indicated otherwise. Shop paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on portions and initial 2-inch of embedded areas only.
1. Do not paint surface which are to be welded or high-strength bolted with friction-type connections.

2. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.
 3. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.
 4. Apply 2-coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first coat.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) as follows:
1. SP-1 "Solvent Cleaning," followed by SP-3 "Power Tool Cleaning."
- C. Painting: Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions. Use painting methods which result in full coverage of joints, corners, edges and exposed surfaces.

2.5 PREFINISHED ROOFING, SIDING AND LINER PANELS

- A. Face Sheets: Fabricate wall and roof panel face sheets to the profile or configuration indicated from minimum 24-gage (0.00179-inch), aluminum-zinc alloy coated steel sheets ("Galvalume") with at least 50,000 p.s.i. yield. Finish shall be manufacturer's standard 3-coat (i.e.: primer, color coat, and clear top coat) "Kynar 500" 70% resin coating.
- B. Lap Seam Roof Panels: Manufacturer's standard factory-formed roof panel system and accessories designed for mechanical attachment of panels to roof purlins and framing. Form panels of minimum 24-gage, aluminum-zinc alloy coated steel sheets ("Galvalume") with 50,000 p.s.i. yield.
1. Roof Panels: American Buildings Long Span III, or approved equivalent by one of the above-named manufacturers.
 2. Finish: Manufacturer's standard 3-coat "Kynar 500" 70% resin coating.
 3. Colors: As selected by OWNER and ENGINEER from manufacturer's full line of standard non-metallic color selections.
- C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 2. Use aluminum or stainless-steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.
 3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.
 4. Provide fasteners with heads matching color of roofing or siding sheets by means of factory-applied coating.
- D. Accessories: Provide the following sheet metal accessories factory-formed of the same material (except 50,000 p.s.i. yield) in the same finish as roof and wall panels:
1. Flashings

2. Closures
3. Fillers
4. Metal expansion joints
5. Fascias and trim
- E. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premolded to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weather tight construction.
- F. Sealing Tape: Pressure-sensitive 100-percent solids gray polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, non-sag, nontoxic, nonstaining tape 2-inch wide and 1/8-inch thick.
- G. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.

2.6 FABRICATION

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.
 1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
 2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.
 1. Shop Connections: Provide power riveted, bolted, or welded shop connections.
 2. Field Connections: Provide bolted field connections.

PART 3 - EXECUTION

3.1 ERECTION

- A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- B. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.
- C. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.
 1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate location.

2. Refer to Division 3 of these specifications for anchor bolt installation requirements in concrete.
- D. Setting Bases and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 1. Set loose and attached base plates and bearing plates for structural members on steel wedges or shims or other adjusting devices.
 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove steel wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 3. Pack grout solidly between bearing surfaces and bases of plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.
 - a. Moist cure grout for not less than 7-days after placement.
- E. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure within specified AISC tolerances.
 2. See base plates with double-nutted anchor bolts, and as otherwise required.
 3. Splice members only where indicated and accepted on shop drawings.
 4. Purlins and Girts: Provide rake or gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door and window arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
 5. Bracing: All sides and end walls to remain open.
 - a. Movement-resisting frames may be used in lieu of sidewall rod bracing, to suit manufacturer's standards.
 - b. Where diaphragm strength of roof or wall covering is adequate to resist wind forces, rod or angle bracing will not be required, except when indicated on Structural Drawings.
 6. Roofing and Siding:
 - a. General: Arrange and nest side lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weather tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.
 - 1) Field cutting of exterior panels by torch is not permitted.
 - 2) Provide weather seal under ridge cap. Flash and seal roof panels at eave, rake, ventilators, and similar locations with rubber, or neoprene, or other acceptable closures to exclude weather and in compliance with warranty requirements.

- b. Roof Sheets: Provide sealant tape at lapped joints of ribbed or fluted roof sheets and between roof sheets and skylights, protruding equipment, roof ventilators, vents, and accessories. Seal joints in roof panels in accordance with roof manufacturer's current written recommendations and requirements.
 - 1) Apply a continuous ribbon of sealant tape to clean, dry surface of the weather side of fastenings on end laps, and on side laps of corrugated nesting-type, ribbed, or fluted panels and elsewhere as needed to make roof sheets weatherproof to driving rains.
- F. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.
 - 1. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Do not enlarge unfair holes in members by burning or by use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- G. Gas Cutting: Do not use gas cutting torches in field for correcting fabrication errors in structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to Architect. Finish gas-cut sections equal to a sheared appearance when permitted.
- H. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections and abraded areas of shop paint. Apply paint to exposed areas with same material as used for shop painting.
 - 1. Apply by brush or spray to provide a minimum dry fill thickness of 2.0-mils.

3.2 FIELD QUALITY CONTROL

- A. Shop Bolted Connections: Inspect in accordance with AISC specifications.
- B. Shop Welding: Inspect during fabrication of structural steel assemblies, as follows:
 - 1. Certify welders and conduct inspections as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspection of all welds.
- C. Field Bolted Connections: Inspect in accordance with AISC specifications.
- D. Field Welding: Inspect during erection of structural steel as follows:
 - 1. Certify welders and conduct inspections as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
 - 2. Perform visual inspection of all welds.

END OF SECTION 13 31 22

SECTION 220000 - GENERAL PLUMBING PROVISIONS

PART 1 - GENERAL

1.1 Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes general provisions covering the contract documents for Plumbing Systems.

1.3 DEFINITIONS

- A. Provide shall mean "Furnish, install and connect."
- B. Piping shall mean "pipe installed with all specified fittings, valves and accessories, and forming a complete system."

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Electrical Coordination: In addition to submittal requirements of other Division 22 Sections, submit a document approved by the project Electrical Contractor certifying that all mechanical equipment being furnished under Division 22 complies with the electrical characteristics of the source power which will be furnished under Divisions 26 and 27.
- C. Model numbers listed on the Mechanical Contract Documents shall not be construed to indicate electrical characteristics. Electrical characteristics of mechanical equipment shall be as indicated on the Electrical Contract Documents (Division 26).
- D. Review of Submittals does not relieve the Contractor of any of the requirements of the Contract Documents. Failure by the Engineer to document errors and omissions in the Contractor's submittals during the Engineer's submittal review does not constitute a waiver of any of the requirements of the original Contract Documents.

1.5 CONTRACTOR QUALIFICATIONS

- A. Plumbing Subcontractor shall have a Class II Unlimited License and shall have demonstrated proficiency in the installation of plumbing systems by the successful installation of systems similar to those included in the Construction Documents for this project. Such systems shall have been installed in commercial or institutional buildings having a minimum of 150 plumbing fixtures (in a single building). The Subcontractor shall have been in business as described above for a minimum period of five years.

- B. A master or journeyman plumber shall be present at the site during the installation of all plumbing related work. The master or journeyman plumber shall be certified in the state in which the construction is being performed and shall have his license present at site or on file during construction.

1.6 PRIOR APPROVALS

- A. Manufacturers References: When reference is made in the Contract Documents to trade names or specific manufacturers and/or models, such reference, unless noted otherwise, is made to designate and identify the quality of materials or equipment to be furnished and is not intended to restrict competitive bidding. If it is desired to use materials or equipment different from those indicated on the Contract Documents, written request for approval must reach the hands of the Design Professional at least TEN DAYS prior to the date set for the opening of bids. A copy of the request should also be sent directly to the Engineer. Requests for prior approval of a proposed substitute shall be accompanied by complete technical data supporting the request.
- B. Request for Prior Approval by facsimile transmission (fax) or email will not be considered. Prior approval requests shall be submitted in hard copy format only.

1.7 LAYOUT AND COORDINATION

- A. Layout Basis:
 - 1. The equipment listed on the Drawings and in the Specifications has been used for the physical arrangement of the mechanical systems. When equipment listed as acceptable, equal or equipment which has received "prior approval" is used, it shall be the Contractor's responsibility to provide structural, ductwork, electrical, service clearances, or other changes required to accommodate the substituted equipment. Changes shall be made at no additional cost to the Owner. Submit a list of required changes along with all prior approval requests and shop drawing submittals.
 - 2. The Contract Drawings are intended to show the general arrangement of all mechanical work. They do not show in detail all offsets, fittings and transitions. Examine Drawings, investigate site conditions to be encountered and arrange work accordingly. Furnish all offsets and transitions required.
 - 3. Drawings do not indicate in detail exact configuration of connections for fixtures, equipment and accessories. Final connection shall be as shown on approved Manufacturer's Submittal Drawings. Where Manufacturer's Submittal Drawings conflict with the Contract Documents, confer with the Design Professional for resolution.
 - 4. Measurement of Drawings by scale shall not be used as dimensions for fabrication. Measurements for locating fixtures, equipment, ductwork, piping and other mechanical items shall be made on the site and shall be based on actual job conditions.
 - 5. Check space limitations and verify electrical requirements before ordering any mechanical equipment or materials. Place large equipment inside the building prior to the erection of exterior walls where equipment cannot enter finished building openings.

- B. Coordination: Mechanical work shall be coordinated with that of other trades to avoid conflict. The Contractor shall study all plans and specifications for this project and shall notify the Design Professional of any conflict between work under Division 22 and work under other divisions of the Project. Particular attention shall be given to interference between piping, electrical installations, structural systems, building openings and ductwork.
- C. Installation Instructions: Two binders containing manufacturer's installation instructions for all equipment furnished under Division 22 shall be furnished by the Contractor. One binder shall be kept in the General Contractor's office at the job site. The other binder shall be delivered to the Engineer upon acceptance by the Design Professional of the Submittals.
- D. Operation and Maintenance Instructions: Three copies of equipment O&M manuals contained in rigid 3-ring binders shall be submitted to the Owner a minimum of 15 days prior to equipment/systems training. Binders shall have permanent labels on the spine and front cover indicating project name, project number, building name and contents. Model and serial numbers of equipment shall be shown on the cover of their respective O&M manual(s).

1.8 PERMITS

- A. Obtain all necessary Permits and Inspections required for the installation of this work and pay all charges incident thereto. Deliver to the Design Professional all certificates of inspection issued by authorities having jurisdiction.
- B. Sewer tap fees, water tap fees, meter fees, Dept. of Labor Fees for Boilers and Pressure Vessels and all other charges for work under Division 22, including charges for meter installation and excess service by the Gas Company or any other utilities shall be paid by the Contractor.

1.9 SAFETY

- A. OSHA Requirements applicable to the project shall be complied with at all times.
- B. Manufacturer's Safety Instructions shall be followed in all instances.
- C. Asbestos Containing Materials (ACM) shall not be used on this project.
- D. Refrigerants containing CFC's or HCFC's shall not be used on this project, nor shall any equipment using such refrigerants be incorporated into this project.
- E. Electrical Equipment Clearances: Piping, equipment and other mechanical installations shall not be located within 42" of the front or 36" of the side of any electrical switchboards, panelboards, power panels, motor control centers, electrical transformers or similar electrical equipment. Piping and ductwork shall not pass through or above electrical equipment rooms except as required to serve those rooms.

- F. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall extend not less than 30 inches beyond each end of such appliances, equipment, fans, components and roof hatch openings and the top of the guard shall be located not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21 inch diameter sphere and shall comply with the loading requirements for guards specified in the International Building Code.

1.10 PROTECTION OF PLUMBING SYSTEMS DURING CONSTRUCTION

A. Material storage:

1. All materials and equipment stored on the jobsite shall be elevated above the ground and stored under suitable weather cover. Materials and equipment shall not be situated in areas subjected to localized flooding.
2. Manufacturer's original shipping packaging and protective coverings shall be left in place until the equipment is prepared for installation.

- B. Roof protection: All penetrations through roofs, including roof vents and roof drainage system elements shall be properly protected during construction to prevent water intrusion into the building. Protective measures could include temporary covers and plugs, as well as other appropriate temporary elements.

C. Electrical enclosure protection:

1. During construction, all protective covers and other devices shall be left in place that protect against inadvertent contact with live electrical circuits.
2. All warning labels related to electrical and rotating equipment hazards shall be in place prior to energizing mechanical equipment circuits.

D. Protection of equipment and piping:

1. Maintain temporary closures on the ends of all equipment and pipes as the installation work progresses. Temporary closures include plastic sheeting, tape and appropriate caps and covers.
2. Where debris enters piping during installation, steps shall be taken to clean the interior of the pipe prior to placing in service.
3. Where debris enters equipment during installation the duct interior shall be cleaned prior to placing in service.

1.11 CODES AND STANDARDS

- A. Mechanical installations shall conform to the current edition of the following, in addition to any previously mentioned Codes and Standards.

1. The International Building Code.
2. The International Mechanical Code.
3. The International Plumbing Code.
4. The International Fire Protection Code.
5. The State Energy Code.
6. NFPA Standard 70, National Electric Code.
7. NFPA Standard 101, Code for Safety to Life for Fire in Buildings and Structures.

1.12 ASBESTOS MATERIALS

- A. Contractor is advised there may be ASBESTOS PRODUCTS in building(s) which will affect work under this Project. Particular reference is made to piping, equipment and other items that may be modified or removed. It shall be the sole responsibility of Contractor to check for and ascertain presence of asbestos materials where such presence affects work under this Project. Where Contractor ascertains presence of asbestos materials, he shall notify Owner and Engineer in writing of presence of asbestos BEFORE beginning any work. Removal of asbestos products shall be the responsibility of Owner AFTER he has been notified by Contractor of its presence.
- B. Engineer assumes no responsibility of investigating for presence of ASBESTOS PRODUCTS or for verifying presence of asbestos materials, nor does Engineer assume any responsibility for specifying, advising on, or supervising removal of any asbestos products. Contractor and Owner shall hold harmless Engineer in any matters involving presence of, or removal of, asbestos products.

PART 2 - PRODUCTS Not required for this section.

PART 3 - EXECUTION Not required for this section.

END OF SECTION 220000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 22 sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Labeling and identifying mechanical systems and equipment is specified in Division 22.
 - 5. Nonshrink grout for equipment installations.
 - 6. Field-fabricated metal and wood equipment supports.
 - 7. Installation requirements common to equipment specification Sections.
 - 8. Mechanical demolition.
 - 9. Cutting and patching.
 - 10. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for following piping specialties:
 - 1. Mechanical sleeve seals.
 - 2. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Prepare coordination drawings of Mechanical Rooms to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
 - 1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve stem movement.
 - b. Planned duct systems layout, including elbow radii and duct accessories.
 - c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - e. Equipment service connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Fire-rated wall and floor penetrations.
 - h. Sizes and location of required concrete pads and bases.
 - 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 - 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
- G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- E. Coordinate all electrical service requirements for mechanical equipment prior to the submittal of shop drawings. Confirm the compatibility of all power services with the equipment being furnished. Confirm compatibility of electrical lugs being provided by the equipment manufacturer with the power wiring being furnished under Division 26. Furnish written documentation that all characteristics have been coordinated with and confirmed by the electrical subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 22 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch minimum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
 - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
 - 3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- E. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
 - 1. Poly (Vinyl Chloride) (PVC): ASTM D 2564.
 - 2. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
- K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
 - 1. Inside Diameter: Closely fit around pipe, tube, and insulation.
 - 2. Outside Diameter: Completely cover opening.
 - 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Polished chrome plate.

4. Cast Brass: Split casting, with concealed hinge and set-screw.
 - a. Finish: Polished chrome plate.
 5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
 6. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
 7. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
 8. Cast-Iron Floor Plate: One-piece casting.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 2. Insulating Material: Suitable for system fluid, pressure, and temperature.
 3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
 7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.
- C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
- D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
 4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.

- a. Penetrating Pipe Deflection: 5 percent without leakage.
 - b. Housing: Ductile-iron casting having water-stop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
 - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.
5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
- a. Under-deck Clamp: Clamping ring with set-screws.

2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: An accessible and visible location.
- C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch -high letters for ductwork and not less than 3/4-inch -high letters for access door signs and similar operational instructions.
 1. Material: Fiberboard.
 2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 3. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- F. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine sub-core, except when other colors are indicated.

1. Fabricate in sizes required for message.
 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 3. Punch for mechanical fastening.
 4. Thickness: 1/16 inch, except as otherwise indicated.
 5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- G. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:
1. Blue: Equipment and components.
 2. For hazardous equipment, use colors and designs recommended by ASME A13.1.
 3. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
 4. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- H. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

2.6 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide UL Listed firestopping system for filling openings around penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1. Specified Technologies, Inc.
 - 2. 3M Corporation
 - 3. Metacaulk.
 - 4. Hilti, Inc.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 22 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, suspended ceilings, cabinet interiors and other exposed locations, according to the following:
1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
 2. Un-insulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
 3. Un-insulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge and chrome-plated finish.
 5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, exterior walls and where indicated.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 2. Build sleeves into new walls and slabs as work progresses.
 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
 - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
 - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation in non-rated floors and partitions, using elastomeric joint sealants. EXCEPTION: Fire rated partition penetrations shall be sealed with U.L. Listed fire-stopping systems.
- O. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and elastomeric sealant. Size sleeve for 1/2-inch annular clear space between pipe and sleeve for installation of sealant.
1. Install steel pipe for sleeves smaller than 6 inches.
 2. Install sheet metal sleeve assembly for sleeves 6 inches and larger.
 3. Install cast iron sleeves according to manufacturer's preprinted instructions.

- P. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with U.L. Listed firestopping sealant system.
- Q. Verify final equipment locations for roughing in.
- R. Refer to equipment specifications in other Sections for roughing-in requirements.
- S. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
 4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
 - a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
 - b. Poly (Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
 - c. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

- T. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
 2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 3. Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Design Professional.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Stenciled Markers: Complying with ASME A13.1.
 2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
 3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.

- g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
- C. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

- A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Paint all exposed steel surfaces of piping and supports with one coat of primer and two coats of enamel.

3.5 CONCRETE BASES

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete with 6 x 6 x #10 reinforcing wire mesh. Outdoor concrete bases shall extend a minimum of 4" above grade and be a minimum thickness of 6".

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.9 GROUTING

- A. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 220500

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes meters and gages used in mechanical systems.

1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of meter, gage, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.
- C. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and compliance with specified requirements.

1.4 QUALITY ASSURANCE

- A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.
- B. Design Criteria: The Drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gages and are based on the specific manufacturer types and models indicated. Meters and gages having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Design Professional. The burden of proof for equality of meters and gages is on the proposer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Liquid-in-Glass Thermometers:
 - a. Marsh Instrument Co.
 - b. Marshalltown Instruments, Inc.
 - c. H.O. Trerice Co.
 - d. Weiss Instruments, Inc.
 - e. Weksler Instruments Corp.
2. Pressure Gages:
 - a. AMETEK, U.S. Gauge Div.
 - b. Ashcroft by Dresser Industries, Instrument Div.
 - c. Marsh Instrument Co.
 - d. Marshalltown Instruments, Inc.
 - e. H.O. Trerice Co.
 - f. Weiss Instruments, Inc.
 - g. Weksler Instruments Corp.
 - h. WIKA Instruments Corp.

2.2 THERMOMETERS, GENERAL

- A. Scale Range: Temperature ranges for services listed as follows:
 1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 LIQUID-IN-GLASS THERMOMETERS

- A. Description: ASTM E 1, liquid-in-glass thermometer.
- B. Case: Die-cast aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
- C. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Tube: Red-reading, organic liquid-filled with magnifying lens.
- E. Scale: Satin-faced non-reflective aluminum with permanently etched markings.
- F. Stem: Copper-plated, steel, aluminum, or brass for a separable socket of length to suit installation.

2.4 THERMOMETER WELLS

- A. Description: Brass or stainless-steel thermometer well.
- B. Pressure Rating: Not less than piping system design pressure.
- C. Stem Length: To extend to center of pipe.
- D. Extension for Insulated Piping: 2 inches nominal, but not less than thickness of insulation.
- E. Threaded Cap Nut: With chain permanently fastened to well and cap.

2.5 PRESSURE GAGES

- A. Description: ASME B40.1, Grade A phosphor-bronze Bourdon-tube pressure gage, with bottom connection.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch -diameter glass lens.
- C. Connector: Brass, 1/4-inch.
- D. Scale: White-coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1 percent of range span.
- F. Range: Conform to the following:
 - 1. Fluids Under Pressure: 2 times operating pressure.

2.6 PRESSURE-GAGE ACCESSORIES

- A. Snubbers: 1/4-inch brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 METER AND GAGE APPLICATIONS

- A. General: Where indicated, install meters and gages of types, sizes, capacities, and with features indicated.

3.2 METER AND GAGE INSTALLATION, GENERAL

- A. Install meters, gages, and accessories according to manufacturers' written instructions for applications where used.

3.3 THERMOMETER INSTALLATION

- A. Install thermometers and adjust vertical and tilted positions. Install in the locations indicated on the drawings.
- B. Install in the following locations and elsewhere as indicated:
 - 1. At inlet and outlet of each thermal storage tank, water heater or mixing valve.
- C. Remote-Reading Dial Thermometers: Install in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- D. Thermometer Wells: Install in vertical position in piping tees where thermometers are indicated.
 - 1. Install wells with stem extending to center of pipe.
 - 2. Fill wells with oil or graphite and secure caps.

3.4 PRESSURE GAGE INSTALLATION

- A. Install pressure gages in piping tee with pressure gage valve located on pipe at most readable position. Install in locations indicated on the drawings.
- B. Install in the following locations and elsewhere as indicated:
 - 1. At building water service entrance.
- C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon instead of snubber for steam pressure gages.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. The Drawings indicate the general arrangement of piping, fittings, and specialties.
- B. Install meters and gages adjacent to machines and equipment to allow servicing and maintenance.

3.6 ADJUSTING AND CLEANING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- C. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519

SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. American Valve Co.
2. Crane Company; Valves and Fitting Division.
3. Hammond Valve Corporation.
4. Appollo/Conbraco Ind. Inc.
5. Milwaukee Valve Company, Inc.
6. NIBCO Inc.
7. Powell Valves
8. Red-White Valve Corp.
9. Stockham Valves & Fittings, Inc.
10. Kitz Corporation of America

2.2 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Non-rising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated. All valves shall be a full port design.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Lever Handles: For quarter-turn valves 6 inches and smaller.

- E. Threads: ASME B1.20.1.
- F. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- G. Solder Joint: ASME B16.18.
 - 1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

- A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction with threaded packing gland on the valve stem seal; chrome-plated brass ball, full port; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
 - 1. Operator: Vinyl-covered steel lever handle.

2.4 CHECK VALVES

- A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
- B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.
- C. Wafer Check Valves: Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.
- D. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Remove the cap and disc holder of swing check valves having composition discs.
- E. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- F. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-1/2 Inches and Smaller: Solder ends or threaded ends.

3.7 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves (as indicated) for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Ball Valves: Class 150, 600-psi CWP, with stem extension.
 - 2. Bronze Swing Check: Class 125, with rubber seat.

3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings or alternate rust preventing shop coating.
 - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.

- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
 - 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, non-gaseous and is recommended for both interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Water: Potable.
 - 4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support all piping direct from structure and independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on insulated piping. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

	LENGTH	THICKNESS
<u>NPS (Inches)</u>	<u>(Inches)</u>	<u>(Inches)</u>
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105
 - 4. Pipes 6 Inches and Larger: Include shield inserts.
 - 5. Insert Material: Length at least as long as the protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. Paint all exposed steel surfaces with one coat of primer and two coats of enamel.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.1 SUMMARY

- A. This Section includes heat tracing with the following electric heating cables:

- 1. Self-regulating, parallel resistance.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
 - 1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.4 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.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Material Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
 1. Chromalox, Inc.
 2. Raychem
 3. Thermon
- C. Heating Element: Pair of parallel 16 AWG tinned copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled non-heating leads with connectors at one end and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- D. Electrical Insulating Jacket: Flame-retardant polyolefin.
- E. Cable Cover: Tinned-copper or Stainless-steel braid and polyolefin outer jacket with UV inhibitor.
- F. Maximum Operating Temperature (Power On): 150 deg F (65 deg C).
- G. Maximum Exposure Temperature (Power Off): 185 deg F (85 deg C).
- H. Maximum Operating Temperature: 300 deg F (150 deg C).
- I. Capacities and Characteristics:
 1. Maximum Heat Output: 5 W/ft. (16.4 W/m).
 2. Maintain 40°F based on a ambient temperature of 15°F.

2.2 CONTROLS

- A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
- B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
- C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

- D. Corrosion-resistant, waterproof control Nema 3R enclosure.

2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Refer to Division 22 Sections.
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils (0.08 mm) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide heat trace system based on piping installation requirements.
- B. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables according to IEEE 515.1.
- E. Install insulation over piping with electric cables according to Division 22 section "Plumbing Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.

- H. Protect installed heating cables, including non-heating leads, from damage.
- I. Set to disable heating cables at 40 deg. F

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Sections.
- B. Connect wiring according to Division 26 Sections.

3.4 FIELD QUALITY CONTROL

- A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 1. Test cables for electrical continuity and insulation integrity before energizing.
 - 2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 220533

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and equipment insulation.

1.3 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal resistivity is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.
- E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.
- F. Density: Is expressed in lb./cu.ft.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Glass Fiber:
 - a. CertainTeed Corporation.
 - b. Knauf Fiberglass GmbH.
 - c. Manville.
 - d. Owens-Corning Fiberglas Corporation.
 - e. USG Interiors, Inc. - Thermafiber Division.

2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
 1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
 2. Density: 3 pcf minimum.
- D. Adhesive: Produced under the UL Classification and Follow-up service.
 1. Type: Non-flammable, solvent-based.
 2. Service Temperature Range: Minus 20 to 180 deg F.
- E. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

- A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
 - 1. Tubular Materials: ASTM C 534, Type I.
 - 2. Sheet Materials: ASTM C 534, Type II.
- B. Thermal Conductivity: 0.30 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F.
- C. Coating: Water based latex enamel coating recommended by insulation manufacturer.
- D. Fire Performance Characteristics: Provide material having the following fire performance characteristics as determined by UL in accordance with ASTM Standard E84:

Flame Spread = 25
Smoke Developed = 50

2.4 INSULATING CEMENTS

- A. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
 - 1. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
 - 2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

- A. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
 - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
 - 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
 - 1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
 - 2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

- C. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20 mil thick, high-impact, ultra-violet-resistant PVC.

- 1. Adhesive: As recommended by insulation manufacturer.

2.7 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.

- 1. Water Vapor Permeance: 0.08 perm maximum.
 - 2. Temperature Range: Minus 20 to 180 deg F.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
 - 1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

- H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
 - 1. Vibration control devices.
 - 2. Testing laboratory labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Sanitary drainage and vent piping. (Drainage piping receiving air conditioning condensate shall be insulated.)
 - 5. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.

3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
 - 3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. 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 on center.
 - a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
 - 4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
 - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
 - 6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

- F. Wall and Partition Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- G. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with a U.L. Listed firestopping or fire-resistant joint sealer.
- H. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.
- I. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply pre-molded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
 - 1. Use same material and thickness as adjacent pipe insulation.
 - 2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
 - 3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
 - 4. Insulate elbows and tees smaller than 3 inches pipe size with premolded insulation.
 - 5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
 - 6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
- J. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments."

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

- A. Bond insulation to pipe with lagging adhesive.
- B. Seal exposed ends with lagging adhesive.
- C. Seal seams and joints with vapor barrier compound.

3.5 JACKETS

- A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3 inch wide butt strips at end joints.
 - 1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound (mastic) and glass tape (glassfab).

3.6 APPLICATIONS

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Domestic cold water.
2. Storm water.
3. Domestic hot water.
4. Recirculated hot water.
5. Sanitary drains for fixtures accessible to the disabled.
6. Drains and sanitary P-traps receiving air conditioning condensate.

3.7 PIPE INSULATION SCHEDULES

A. General: Furnish insulation vapor barrier on all piping carrying fluids below 60°F.

B. Schedules:

1. Domestic Cold, Hot and Recirculation Water (including makeup water piping):
 - a. Domestic Cold Water Piping: 1" rigid fiberglass insulation with vapor barrier.
 - b. Domestic Hot Water and Recirculation Piping: 1" rigid fiberglass insulation for piping 2" and smaller.
2. Storm Drainage Piping:
 - a. Rigid 1" Glass Fiber Insulation:
3. Piping Receiving Air Conditioning Condensate: Rigid 1" glass fiber insulation.

END OF SECTION 220700

SECTION 221116 - WATER DISTRIBUTION PIPING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 DEFINITIONS

- A. Water Service Piping: Water piping outside building that conveys water to building.
- B. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Distribution Piping: 125 psig.

1.5 SUBMITTALS

- A. Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.6 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
- C. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.

2.3 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to other Division 22 sections for commonly used joining materials.
- C. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 VALVES

- A. Refer to Division 22 Section for general-duty valves.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Aboveground, Water Distribution Piping: Use the following:
 - 1. 3-Inch NPS and Smaller: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.

3.2 APPLICATIONS

- A. Drawings indicate types to be used. Where specific types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use ball valves.

3.3 PIPING INSTALLATION, GENERAL

- A. Refer to other Division 22 sections for basic piping installation.

3.4 WATER DISTRIBUTION PIPING INSTALLATION

- A. Install piping with 0.25 percent slope downward toward drain.

3.5 JOINT CONSTRUCTION

- A. Refer to other Division 22 sections for basic piping joint construction.

3.6 INSTALLATION

- A. Sectional valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated.
- B. Shutoff Valves: Install shutoff on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated.

- C. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Refer to other Division 22 sections for pipe hanger and support devices. Install the following:
1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs of piping sizes 2½ -inches and larger.
 3. Adjustable steel swivel loop hangers, MSS Type 10, for individual straight, horizontal runs of piping 2-inches and smaller.
- B. Install supports according to Division 22 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
1. 3/4-Inch NPS and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 2. 1-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 3. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 4. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
1. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 2. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code.
 3. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff and union for each connection.

3.9 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:

1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test water distribution piping as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
- c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
- d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.11 COMMISSIONING

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
- E. Energize pumps and verify proper operation.

END OF SECTION 221116

SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing specialties for the following:

1. Water distribution systems.
2. Soil, waste, and vent systems.
3. Storm drainage systems.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Water Distribution Piping: 125 psig.
2. Soil, Waste, and Vent Piping: 10-foot head of water.
3. Storm Drainage Piping: 10-foot head of water.

1.4 SUBMITTALS

- A. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:

1. Thermostatic water mixing valves.
2. Water hammer arresters.
3. Drain trap seals.
4. Hose bibbs and hydrants.
5. Outlet boxes.
6. Cleanouts.
7. Floor drains and open receptors.
8. Vent terminals, and roof flashing assemblies.

- B. Reports: Specified in "Field Quality Control" Article.

C. Maintenance Data: For specialties to include in the maintenance manuals. Include the following:

1. Thermostatic water mixing valves.
2. Hydrants.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing specialties and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered.
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled.
1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- E. Comply with NFPA 70, "National Electrical Code," for electrical components.
- F. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Thermostatic Water Mixing Valves:
 - a. Appollo/Conbraco Industries, Inc.
 - b. Bradley Corp.
 - c. Lawler Manufacturing Co., Inc.
 - d. Leonard Valve Co.
 - e. Mark Controls Corp.; Powers Process Controls.
 - f. Symmons Industries, Inc.

2. Outlet Boxes:
 - a. Acorn Engineering Co.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corp.
 - d. LSP-Specialty Products Co.
 - e. Oatey Co.
 - f. Plastic Oddities, Inc.
 - g. Symmons Industries, Inc.
3. Wall Hydrants:
 - a. Josam Co.
 - b. Smith: Jay R. Smith Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Woodford Manufacturing Co.
 - f. Zurn Industries, Inc.; Hydromechanics Div.
4. Roof Hydrants:
 - a. Mapa MPH-24-FP
 - b. J.R. Smith 5903
 - c. Woodford SRH-MS
5. Water Hammer Arresters:
 - a. Josam Co.
 - b. Smith: Jay R. Smith Mfg. Co.
 - c. Tyler Pipe; Wade Div.
 - d. Watts Industries, Inc.;
 - e. Zurn Industries, Inc.; Hydromechanics Div.
6. Drain Trap Seals:
 - a. J. R. Smith; Quad Close
 - b. Proset Trap Guard
 - c. Rectorseal Sure Seal
 - d. IPS Green Drain
7. Cleanouts:
 - a. Josam Co.
 - b. Mifab
 - c. Smith: Jay R. Smith Mfg. Co.
 - d. Tyler Pipe, Wade Div.
 - e. Watts
 - f. Zurn Industries, Inc., Hydromechanics Div.

8. Floor Drains:

- a. Josam Co.
- b. Mifab
- c. Smith: Jay R. Smith Mfg. Co.
- d. Tyler Pipe, Wade Div.
- e. Watts
- f. Zurn Industries, Inc., Hydromechanics Div.

2.2 THERMOSTATIC WATER MIXING VALVES

- A. General: ASSE 1017, manually adjustable, thermostatic water mixing valve with bronze body. Include check stop and union on hot- and cold-water-supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
 1. Bimetal Thermostat, Operation and Pressure Rating: 125 psig minimum.
 2. Liquid-Filled Motor, Operation and Pressure Rating: 100 psig minimum.
- B. Thermostatic Water Mixing Valves: Unit, with the following:
 1. Piping, of sizes and in arrangement indicated. Include valves and unions.
 2. Piping Component Finish: Rough brass.
 3. Thermometer: Manufacturer's standard.

2.3 OUTLET BOXES

- A. General: Recessed-mounting outlet boxes with fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.
- B. Ice Maker Outlet Boxes: With hose connection and the following:
 1. Box and Faceplate: Plastic.
 2. Shutoff Fitting: Supply stop.
 3. Supply Fitting: 1/4-inch NPS copper, water tubing.
- C. Condensate Drain Box: Stainless steel box and face plate; hinged and lockable door; 1½-inch drain fitting; see drawing detail for piping requirements.
- D. Reinforcement: 2-by-4-inch- or 2-by-6-inch-, fire-retardant-treated-wood blocking between studs.

2.4 HYDRANTS

- A. Wall Hydrants: ASME A112.21.3M or ASSE 1019, non-freeze, automatic draining, anti-backflow type, key operation, with 3/4- or 1-inch NPS threaded or solder-joint inlet, and ASME B1.20.7 garden-hose threads on outlet. Include operating key for each hydrant.

1. Type: Recessed.
2. Finish: Nickel bronze.

- B. Roof Hydrants: ASSE 1057, non-freeze, automatic draining with 3/4-inch inlet and garden hose outlet. Include roof flashing and under-deck flange.

2.5 DRAIN TRAP SEALS

- A. Drain Trap Seals: Fitting installs in drain body outlets to block sewer gases.

1. ASSE 1072 compliant.
2. HDPE or DBS plastic frame with silicon or EDPM sealing gasket.

2.6 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arrestors: Provide water hammer arrestors where indicated on drawings. Unit shall be constructed of stainless-steel bellows arranged in a pressurized expansion chamber and shall have lifetime warranty. Units shall have P.D.I symbol that relates to fixture unit rating. Units shall be J.R. Smith 5000 Series "Hydro-Trol." Equal products by Josam, Smith, Wade or Zurn will be acceptable.

- B. Hose Bibbs: Bronze body, with renewable composition disc, 1/2- or 3/4-inch NPS threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, non-removable, drainable, hose-connection vacuum breaker.

1. Finish: Rough brass.
2. Operation: Operating-key (handle) type. Include operating key.

- C. Roof Flashing Assemblies: Manufactured assembly made of 4-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe with galvanized steel boot reinforcement, and counter-flashing fitting.

- D. Open Drains: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section of length to provide depth indicated; and where indicated, increaser fitting of size indicated, joined with ASTM C 564 rubber gaskets. Size P-trap as indicated.

- E. Deep-Seal Traps: Cast iron or bronze, with inlet and outlet matching connected piping, cleanout where indicated, and trap seal primer valve connection where indicated.

1. 2-Inch NPS: 4-inch-minimum water seal.
2. 2-1/2 Inch NPS and Larger: 5-inch-minimum water seal.

- F. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counter-flashing, as indicated.

2.7 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4 lb/sq. ft. or 0.0625-inch thickness.
 - 2. Vent Pipe Flashing: 3 lb/sq. ft. or 0.0469-inch thickness.
 - 3. Burning: 6 lb/sq. ft. or 0.0937-inch thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Solder: ASTM B 32, lead-free alloy.
- F. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.8 CLEANOUT

- A. Cleanout: Where plumbing specialties of this designation are indicated, provide products complying with the following and with the Fixture Schedule on the drawings.
 - 1. Applicable Standard: ASME A112.36.2M. ASME A112.3.1.

2.9 FLOOR DRAIN

- A. Floor Drain: Where plumbing specialties of this designation are indicated, provide products complying with the following and with Fixture Schedule on drawings:
 - 1. Applicable Standard: ASME A112.21.1M. ASME A112.21.1M floor drain with ASME A112.14.1 backwater valve. ASME A112.3.1.

PART 3 – EXECUTION

3.1 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install hose bibbs with integral or field-installed vacuum breaker.
- C. Install wall hydrants with integral or field-installed vacuum breaker.

- D. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
1. Size same as drainage piping up to 4-inch NPS. Use 4-inch NPS for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping 3-inch NPS and smaller and 80 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- E. Install cleanout deck plates, of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.
- F. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
- G. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- H. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- I. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.
- J. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed.
- K. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- L. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
- M. Position floor drains for easy access and maintenance.
- N. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- O. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.
- P. Secure supplies to supports or substrate.
- Q. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.
- R. Install water-supply stop valves in accessible locations.
- S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

- T. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- U. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.
- V. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.
- W. Anchor roof hydrants to roof deck. Anchor in accordance with manufacturer's instructions. Coordinate flashing with roofing installer.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing specialties and piping specified in other Division 22 sections.
 - 2. Install piping connections indicated between appliances and equipment specified in other Sections; connect directly to plumbing piping systems.
 - 3. Install piping connections indicated as indirect wastes from appliances and equipment specified in other Sections, to spill over receptors connected to plumbing piping systems.
- B. Install hoses between plumbing specialties and appliances as required for connections.
- C. Arrange for electric-power connections to plumbing specialties and devices that require power.
- D. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.
- E. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing manufactured from single piece unless large pans, sumps, or other drainage shapes are required.
- B. Burn joints of lead sheets where required.
- C. Solder joints of copper sheets where required.

- D. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- E. Set flashing on floors and roofs in solid coating of bituminous cement.
- F. Secure flashing into sleeve and specialty clamping ring or device.
- G. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
- H. Fabricate and install flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection if indicated.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise the field assembly of components and installation of grease recovery units, including piping and electrical connections, and to report results in writing.
 - 1. Test and adjust plumbing specialty controls and safeties. Replace damaged and malfunctioning controls and components.

3.5 COMMISSIONING

- A. Before startup, perform the following checks:
 - 1. System tests are complete.
 - 2. Damaged and defective specialties and accessories have been replaced or repaired.
 - 3. Clear space is provided for servicing specialties.
- B. Before operating systems, perform the following steps:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open general-duty valves to fully open position.
 - 3. Remove and clean strainers.
 - 4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
 - C. Adjust operation and correct deficiencies discovered during commissioning.

3.6 PROTECTION

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

END OF SECTION 221119

SECTION 221123 - WATER DISTRIBUTION PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following types of water distribution pumps for plumbing systems:

- 1. In-line circulators.

1.3 PUMP PERFORMANCE REQUIREMENTS

- A. Pump Pressure Ratings: At least equal to system maximum operating pressure at point where installed.
- B. Selection Point: All pump design operating points shall be left of the maximum efficiency point on the pump curve. Pump inlet fluid velocity shall not exceed 12 feet per second.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories. Include startup instructions.
- C. Shop drawings showing layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.
- D. Wiring diagrams detailing wiring for power, signal, and control systems differentiating between manufacturer-installed wiring and field-installed wiring.
- E. Product certificates signed by pump manufacturers certifying accuracies under specified operating conditions and compliance with specified requirements.
- F. Maintenance data for each type and size pump specified to include in the Operating and Maintenance Manual.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following:

1. ASME B31.9 "Building Services Piping" for piping materials and installation.
 2. H.I. "Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps" for pump design, manufacture, and installation.
 3. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
 4. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
 5. NFPA 70 "National Electrical Code" for electrical components and installation.
- B. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer.
- C. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer with pumps, components, and accessories from a single source. Include responsibility and accountability to answer and resolve problems regarding compatibility, installation, performance, and acceptance of pumps.
- D. Design Criteria: Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Design Professional. The burden of proof for equality of pumps is on the proposer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps in a clean, dry location.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, or other foreign matter.
- D. Extended Storage Greater Than 5 Days: Dry internal parts with hot air or a vacuum-producing device. After drying, coat internal parts with light oil, kerosene, or antifreeze. Dismantle bearings and couplings, dry and coat with an acid-free heavy oil, and tag and store in a dry location.
- E. Comply with pump manufacturer's rigging instructions for handling and supporting.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. In-Line Circulators:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Div., ITT Fluid Technology Corp.
 - d. Dunham-Bush, Inc.
 - e. Grundfos Pumps Corp.
 - f. Taco, Inc.
2. Aquastats:
 - a. Honeywell
 - b. Johnson
 - c. Robert Shaw
 - d. Barbar Coleman

2.2 PUMPS, GENERAL

- A. Water Distribution Pumps: Factory assembled and tested.
- B. Capacities and Characteristics: As indicated.
- C. Motors: NEMA MG 1; single, multiple, or variable speed with type of enclosure and electrical characteristics indicated. Include built-in thermal-overload protection and grease-lubricated ball bearings. Motors are non-overloading within full range of pump performance curves.
- D. Finish: Manufacturer's standard paint applied to factory-assembled and -tested plumbing pump units before shipping.
- E. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

2.3 IN-LINE CIRCULATORS

- A. General Description: Horizontal, in line, centrifugal, single stage, rated for 125-psig minimum working pressure and 225 deg F continuous water temperature.
- B. In-Line Circulator: Leakproof, in-line, seal-less, volute-type pump. Include pump and motor assembled on a common shaft in a hermetically sealed unit, without stuffing boxes or mechanical seals. Lubricate sleeve bearing and cool motor by circulating pumped liquid through motor section. Isolate motor section from motor stator windings with a corrosion-resistant, nonmagnetic alloy liner.
 1. Casing: Bronze and static O-ring seal to separate motor section from motor stator, and flanged piping connections.
 2. Impeller: Overhung, single-suction, closed or open nonmetallic impeller.
 3. Shaft and Sleeve: Ceramic shaft with carbon-steel bearing sleeve.

2.4 GENERAL-DUTY VALVES

- A. Refer to other Division 22 sections for general-duty gate, ball, butterfly, globe, and check valves.

2.5 AQUASTATS

- A. General Description: Metal enclosure, strap-on mounting, visible point scale, external adjustment screw, 65EF to 200EF operating range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections prior to pump installation.

3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for base-mounted pumps. Refer to s22 Sections.

3.3 INSTALLATION

- A. Install pumps according to the manufacturer's written installation instructions.
- B. Install pumps in locations indicated and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so that weight of piping is not supported by pumps.
- D. Suspend vertical, in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support weight of pumps.
- E. Secure aquastat to hot water return piping upstream of circulating pump.

3.4 CONNECTIONS

- A. Connect piping to pumps as indicated. Install valves that are same size as piping connecting to pumps.

- B. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- C. Install shutoff valve on suction side of in-line pumps and circulators.
- D. Install check valve and throttling valve on discharge side of in-line pumps and circulators.
- E. Install electrical connections for power, controls, and devices.
- F. Electrical power and control wiring and connections are specified in Division 26 Sections.

3.5 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Pump Controls: Set pump controls for automatic start, stop, and alarm operation.

3.6 COMMISSIONING

- A. Final Checks Before Startup: Perform the following preventive maintenance operations and checks before startup:
 - 1. Remove grease-lubricated bearing covers and flush bearings with kerosene and thoroughly clean. Fill with new lubricant according to manufacturer's recommendations.
 - 2. Disconnect couplings and check motors for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - 3. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if bound or if it drags even slightly until cause of trouble is determined and corrected.
 - 4. Check that pump controls are correct for required application.
- B. Starting procedure for pumps with shutoff power not exceeding safe motor power:
 - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
 - 2. Open the liquid supply valves if pumps are so fitted.
 - 3. Open circulating line valves if pumps should not be operated against dead shutoff.
 - 4. Start motors.
 - 5. Open discharge valves slowly.
 - 6. Observe leakage from stuffing boxes and adjust sealing liquid valves for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes, then tighten glands.
 - 7. Check general mechanical operation of pumps and motors.
 - 8. Close circulating piping valves once there is sufficient flow through pumps to prevent overheating.
 - 9. Remove startup strainers from suction diffusers and install permanent strainers after system has been in operation.
 - 10. Set aquastat operating temperature for 5°F less than hot water supply temperature.

- C. When pumps are to be started against closed check valves with discharge gate valves open, steps are same except open discharge gate valves some time before motors are started.

END OF SECTION 221123

SECTION 22 13 16 - DRAINAGE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.
- B. Air conditioning condensate drain piping shall be considered the same piping as storm drain piping.

1.3 DEFINITIONS

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.
- B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building.
- C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping.
- D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- E. The following are industry abbreviations for plastic and other piping materials:
 - 1. PVC: Polyvinyl chloride.
- F. Underground Piping: Piping located below slab or grade and to within 6-inches above slab or grade.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Systems: 10-foot head of water.
 - 2. Storm Drainage Systems: 10-foot head of water.

1.5 SUBMITTALS

- A. Test Results and Reports: Specified in "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe: ASTM D 2665, Schedule 40.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Threaded-Fitting, End Connections: ASME B1.20.1.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

2.3 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Division 22 Section for commonly used joining materials.
- C. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; made by piping system manufacturer for joining system piping.
- D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, and Vent Piping: Use the following:
 - 1. 4-Inch NPS or smaller: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, Soil, Waste, and Vent Piping: Use the following:
 - 1. 4-Inch NPS and smaller: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
- E. Aboveground, Storm Drainage Piping: Use the following:
 - 1. 8-Inch NPS and smaller: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, Storm Drainage Piping: Use the following:
 - 1. 6-Inch NPS and smaller: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION, GENERAL

- A. Refer to Division 22 Section for basic piping installation.

3.3 SERVICE ENTRANCE PIPING INSTALLATION

- A. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- B. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.
- C. Install sleeve at each service entrance pipe penetration through foundation wall. Refer to Division 22 Section for sleeves.

3.4 DRAINAGE AND VENT PIPING INSTALLATION

- A. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- B. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- C. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS and smaller; 1 percent downward in direction of flow for piping 4-inch NPS and larger.
 - 2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Storm Building Drain: 1 percent downward in direction of flow.
 - 4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
 - 5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- D. Install PVC plastic drainage piping according to ASTM D 2665.
- E. Install underground PVC plastic drainage piping according to ASTM D 2321.
- F. Do not install PVC piping in HVAC plenums unless otherwise noted. Install cast iron piping in all plenum locations.

3.5 JOINT CONSTRUCTION

- A. Refer to other Division 22 sections for basic piping joint construction.
- B. PVC Piping Joints: Join drainage piping according to ASTM D 2665.
- C. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 22 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
 - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
 - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs.

- B. Install supports according to Division 22 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 - 2. 4-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 - 3. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

3.8 ACCESSORIES INSTALLATION

- A. Install accessories according to manufacturer's written instructions and as indicated.

3.9 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

- a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gas tight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- C. Contractor shall run sewer camera in all interior storm and sewer mains 4" and larger (excluding water closet runouts.) The video shall be provided in "wmv" DVD format. Each video shall be narrated so that it is clear which pipe is being video taped.
1. Schedule video taping session at least five (5) days in advance, with the Design Professional and Owner's representative so they may have the opportunity to witness the session if they so desire.
 2. Provide Design Professional with one (1) copy of video tape.

3.10 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION 221316

SECTION 223300 - ELECTRIC WATER HEATERS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes electric water heaters and accessories.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate dimensions, finishes and coatings, required clearances, methods of assembly of components, and piping and wiring connections.
- C. Shop Drawings showing layout of each unit, including tanks, pumps, controls, related accessories, and piping.
- D. Setting Drawings with templates and directions for installing foundation bolts, anchor bolts, and other anchorages.
- E. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between factory-installed and field-installed wiring.
- F. Product certificates signed by manufacturers of water heaters certifying that their products comply with specified requirements.
- G. Certificates of shop inspection and data report as required by provisions of ASME Boiler and Pressure Vessel Code, when ASME construction is indicated.
- H. Field quality-control installation reports.
- I. Maintenance data for water heaters to include in operation and maintenance manuals. Include startup instructions.

1.4 QUALITY ASSURANCE

- A. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.1, "Energy Efficient Design of New Buildings."
- B. NFPA Standard: Comply with NFPA 70, "National Electrical Code," for electrical components.
- C. Listing and Labeling: Provide electrically operated water heaters, controls, and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- D. Product Options: Drawings indicate size, profiles, connections, dimensional requirements, and characteristics of water heaters and accessories and are based on specific types and models indicated. Other manufacturers' water heaters and accessories with equal performance characteristics may be considered.

1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.
- B. Warranty Period: 3 years after date of Material Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commercial, Storage, Electric Water Heaters:
 - a. Bradford White Corp.
 - b. Lochinvar Corp.
 - c. Precision Parts Corp.
 - d. PVI Industries, Inc.
 - e. Rheem Mfg. Co.; Rheem Water Heater Div.
 - f. Rheem Mfg. Co.; Ruud Water Heater Div.
 - g. Smith: A.O. Smith Water Products Co.
 - h. State Industries, Inc.

2. Expansion Tanks:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Expanflex, Inc.
 - d. Smith: A.O. Smith; Aqua-Air Div.
 - e. State Industries, Inc.

2.2 WATER HEATERS, GENERAL

- A. Specified manufacturer's standard components and features are acceptable where specific product requirements are not indicated.
- B. Temperature Control: Adjustable thermostat, except for units where other arrangement is indicated or temperature is regulated by flow-control fitting.
- C. Safety Control: Automatic, high-temperature-limit cutoff device or system on commercial units and where indicated. Include automatic low-water cutoff device or system on commercial units where indicated.
- D. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.
- E. Tappings: Factory fabricated of materials compatible with tank. Include tappings for piping connections, relief valves, pressure gage, thermometer, blow down, and controls as required and others as indicated. Attach tappings to tank before testing and labeling. Include tappings and connections as follows:
 1. 2-Inch NPS and Smaller: Threaded ends.
- F. Insulation: Fiberglass, polyurethane foam, or manufacturer's standard that is suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.
- G. Jacket: Steel, with baked-on enamel finish, except where otherwise specified.
- H. Anode Rods: Factory installed, magnesium.
- I. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

2.3 COMMERCIAL, STORAGE, ELECTRIC WATER HEATERS

- A. Description: UL 1453, commercial, storage, electric water heater; with capacity more than 40 gal.
- B. Storage Tank Construction: Steel with 150-psig working-pressure rating.

- C. Heating Elements: Electric, screw-in or bolt-on, immersion type according to the following:
 - 1. Up to 9-kW Input: 2 or 3 elements.
 - 2. More than 9-kW Input: Elements arranged in multiples of 3.
- D. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of 3.
- E. Staging: Not exceeding 18 kW per step.
- F. Temperature Control: Adjustable immersion thermostats.
- G. Safety Control: Automatic, high-temperature-limit and low-water cutoffs.
- H. Special Requirements: NSF 5 construction.
- I. Inlet and Outlet Manifolds: Fabricated by water heater manufacturer and capable of providing balanced flow through water heaters, for multiple-unit installation.
- J. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.

2.4 EXPANSION TANKS

- A. Description: Steel, pressured-rated tanks constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air per charge to minimum system-operating pressure at tank.
- B. Construction: 150-psig working-pressure rating.
- C. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for water heaters and accessories. Refer to Division 22 Sections.

3.2 WATER HEATER INSTALLATION

- A. General: Install water heaters on concrete bases. Set and connect units according to manufacturer's written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturer's recommended clearances. Install so controls and devices are accessible for service.
- B. Anchor water heaters and storage tanks to substrate.

- C. Install temperature and pressure relief valves in top portion of storage water heater tanks and hot-water storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.
- D. Install pressure relief valves in hot-water-outlet piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.
- E. Install vacuum relief valves in cold-water-inlet piping.
- F. Install water heater drain piping as direct waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Sections for drain valves.
- G. Install thermometers on water heater inlet and outlet piping. Thermometers are specified in Division 22 Sections.
- H. Install piping adjacent to water heaters to allow service and maintenance.
- I. Arrange for field-applied insulation on equipment and piping not furnished with factory-applied insulation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Connect hot- and cold-water piping to units with shutoff valves and unions. Connect hot-water circulating piping to unit with shutoff valve, check valve, and union.
 - 2. Make connections with dielectric fittings where piping is made of dissimilar metals. Dielectric fittings are specified in Division 22 Sections.
- B. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit servicing.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

- A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
 - 1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Schedule training with Owner with at least 7 days' advance notice.

B. Perform the following final checks before startup:

1. Fill water heaters with water.
2. Check that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Check operation of pumps and circulators.
6. Test operation of safety controls, relief valves, and devices.

C. Perform the following startup procedures:

1. Energize electric circuits.
2. Adjust operating controls.
3. Adjust hot-water-outlet temperature settings.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing fixtures and trim, faucets, other fittings, and related components.

1.3 DEFINITIONS

- A. Accessible: Plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped, disabled, and elderly people.
- B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, traps and waste pipes. Pipe fittings, tube fittings, and general-duty valves are included where indicated.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each plumbing fixture category and type specified. Include selected fixture, trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- C. Wiring diagrams from manufacturer for electrically operated units.
- D. Maintenance data for plumbing fixtures and components to include in the operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category from one source and by a single manufacturer.
 - 1. Exception: Where fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for this category.

- B. Regulatory Requirements: Comply with requirements of 2010 ADA Standards for Accessible Design; regarding plumbing fixtures for physically handicapped people.
- C. Energy Policy Act Requirements: Comply with requirements of Public Law 102-486, "Energy Policy Act," regarding water flow rate and water consumption of plumbing fixtures.
- D. Listing and Labeling: Provide electrically operated fixtures and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing fixtures and are based on specific types and models indicated. Other manufacturers' fixtures with equal performance characteristics may be considered.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.
- B. Store plumbing fixtures on elevated platforms in dry location.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Coordinate roughing-in and final fixture locations and verify that plumbing fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURE STANDARDS

- A. Comply with applicable standards below and other requirements specified.
 - 1. Electric Water Coolers: ARI 1010 and UL 399.
 - 2. National Sanitation Foundation Construction: NSF 2.
 - 3. Stainless-Steel Fixtures Other than Service Sinks: ASME A112.19.3M.
 - 4. Vitreous-China Fixtures: ASME A112.19.2M.

2.2 LAVATORY/SINK FAUCET STANDARDS

- A. Comply with ASME A112.18.1M and other requirements specified for lavatory, sink, and similar-type-fixture faucet fittings. Include hot- and cold-water indicators; 2.0-gpm-maximum flow rate; and polished, chrome-plated finish; except where otherwise indicated. Coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
2. Faucet Hose: ASTM D 3901.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. Pipe Threads: ASME B1.20.1.
7. Sink Spray Hoses: ASTM D 3573.

2.3 SHOWER FAUCET STANDARDS

- A. Comply with ASME A112.18.1M and other requirements specified for shower faucet fittings. Include hot- and cold-water indicators; 2.5-gpm-maximum flow rate; and polished, chrome-plated finish; except where otherwise indicated. Coordinate faucet inlets with supplies and outlet; and shower head, arm, and flange.
1. Hand-Held Showers: ASSE 1014.
 2. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 3. Hose-Coupling Threads: ASME B1.20.1 or ASME B1.20.7.
 4. Pipe Threads: ASME B1.20.1.
 5. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

2.4 MISCELLANEOUS FITTING STANDARDS

- A. Comply with ASME A112.18.1M and other requirements specified for fittings, other than faucets. Include polished, chrome-plated finish, except where otherwise indicated. Coordinate fittings with other components and connectors.
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Automatic Flow Restrictors: ASSE 1028.
 3. Brass and Copper, Supplies and Tubular Brass: ASME A112.18.1M.
 4. Fixed Flow Restrictors: ASSE 1034.
 5. Manual-Operation Flushometers: ASSE 1037.

2.5 MISCELLANEOUS COMPONENT STANDARDS

- A. Comply with applicable standards below and other requirements specified for components for plumbing fixtures, equipment, and appliances.
1. Hose-Coupling Threads: ASME B1.20.7.
 2. Pipe Threads: ASME B1.20.1.
 3. Plastic Toilet Seats: ANSI Z124.5.
 4. Supply and Drain Insulation Kits: CABO A117.1.

2.6 FITTINGS

A. Supplies:

1. Manufacturers and Models:

- a. A. Y. McDonald 2082 Series
- b. B&K 490 Series
- c. Brasscraft KTCS Series
- d. McGuire BV Series
- e. Watts 894 Series
- f. Zurn 8800 Series

2. Supply Inlet: Brass pipe or copper tube, size required for final connection.

3. Supply Stops: Chrome-plated brass, angle; chrome-plated brass ball; quarter-turn operation; 1/2" compression inlet and 3/8" o.d. compression outlet; same size as supply inlet and with outlet matching supply riser, chrome handle.

4. Supply Risers: 3/8" NPS flexible copper tube with knob end. Use chrome-plated tube for exposed applications.

B. Traps and Wastes:

1. Manufacturers:

- a. McGuire
- b. EBC
- c. Dearborne
- d. Watts
- e. Zurn

2. Traps: Tubular brass with 0.045" (17 ga.) Wall thickness, slip-joint inlet, cleanout, wall flange, escutcheons, and size to match equipment. Use chrome-plated tube for exposed applications.

3. Continuous Waste: Tubular brass, 0.045" (17 ga.) Wall thickness, with slip-joint inlet, and size to match equipment.

4. Indirect Waste: Hard copper DWV tube and solder joint fittings; size to match equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for potable, hot- and cold-water supply piping systems; soil, waste, and vent piping systems; and supports. Verify that locations and sizes of piping and locations and types of supports match those indicated, before installing and connecting fixtures. Use manufacturer's roughing-in data when roughing-in data are not indicated.

- B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Include supports for plumbing fixtures according to the following:
 - 1. Reinforcement: For floor-mounted lavatories and sinks that require securing to wall and recessed, box-mounted, electric water coolers.
 - 2. Fabricate reinforcement from 2-by-4-inch or 2-by-6-inch fire-retardant-treated-wood blocking between studs or 1/4-by-6-inch steel plates attached to studs, in wall construction, to secure fixtures to wall. Include length that will extend beyond ends of fixture mounting bracket and attach to at least 2 studs.
- B. Include fitting insulation kits for accessible fixtures according to the following:
 - 1. Lavatories: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 - 2. Sinks: Cover hot- and cold-water supplies, stops and handles, drain, trap, and waste to wall.
 - 3. Fixtures with Offset Drain: Cover hot- and cold-water supplies, offset drain, trap, and waste to wall.
 - 4. Other Fixtures: Cover exposed fittings below fixture.

3.3 PLUMBING FIXTURE INSTALLATION

- A. Assemble plumbing fixtures and trim, fittings, faucets, and other components according to manufacturers' written instructions.
- B. Install fixtures level and plumb according to manufacturers' written instructions, roughing-in drawings, and referenced standards.
- C. Install floor-mounted, floor-outlet water closets with fittings and gasket seals.
- D. Install toilet seats on water closets.
- E. Install wall-hanging, back-outlet urinals with gasket seals.
- F. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for handicapped people to reach.
- G. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.
- H. Fasten floor-mounted fixtures to substrate. Fasten fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

- I. Fasten recessed, wall-mounted fittings to reinforcement built into walls.
- J. Fasten wall-mounted fittings to reinforcement built into walls.
- K. Fasten counter-mounting plumbing fixtures to casework.
- L. Secure supplies to supports or substrate within pipe space behind fixture.
- M. Set mop basins in leveling bed of cement grout.
- N. Install individual stop valve in each water supply to fixture. Use gate or globe valve where specific stop valve is not specified.
- O. Install water-supply stop valves in accessible locations.
- P. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts when faucets are not available with required rates and patterns. Include adapters when required.
- Q. Install shower, flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets. Omit traps on fixtures having integral traps. Omit traps on indirect wastes, except where otherwise indicated.
- S. Install escutcheons at wall, floor, and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons where required to conceal protruding pipe fittings.
- T. Seal joints between fixtures and walls, floors, and counters using sanitary-type, 1-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Division 22 Sections.
- B. Supply and Waste Connections to Plumbing Fixtures: Refer to plumbing fixture schedules at the end of this Section for fitting sizes and connection requirements for each plumbing fixture.
- C. Supply and Waste Connections to Equipment Specified in Other Sections: Connect equipment with supply inlets, supply stops, supply risers, and traps specified in this Section. Use fitting sizes required to match connected equipment. Connect fittings to plumbing piping.

D. Ground equipment.

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

E. Arrange for electric-power connections to fixtures and devices that require power. Electric power is specified in Division 26 Sections.

3.5 FIELD QUALITY CONTROL

- A. Verify that installed fixtures are categories and types specified for locations where installed.
- B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized and demonstrate proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.6 ADJUSTING AND CLEANING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at drinking fountains, electric water coolers, faucets, shower valves, and flushometer valves having controls, to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Include the following:
 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of fixtures for temporary facilities, except when approved in writing by Owner.

3.8 WATER CLOSET SCHEDULE - FLUSH VALVE TYPE

A. Water Closet: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Vitreous-China Water Closet:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. Zurn Plumbing Products
3. Flushometer Valve:
 - a. American Standard.
 - b. Sloan Valve Co.
 - c. Zurn Industries, Ind., Flush Valve Operations.
4. Toilet Seat:
 - a. Bemis Mfg. Co.
 - b. Centoco Manufacturing Corp.
 - c. Church Seat Co.
 - d. Olsonite Corp.
 - e. Sanderson Plumbing Products, Inc.;
 - f. Sperzel.
 - g. Zurn Plumbing Products
5. Flushometer Valve Operation: Diaphragm.
6. Flushometer Valve Finish: Polished, chrome-plated, exposed metal parts.
7. Flushometer Valve, Water Consumption: Factory set 1.28 gal. maximum per flushing cycle.
8. Flushometer valve components include the following:
 - a. Brass, lever-handle actuation.
 - b. Non-hold-open feature.
9. Toilet Seat: Solid-plastic, water-closet seat with bumpers and hardware, compatible with water closet and as follows:
 - a. Class: Commercial, Extra-Heavy-Duty type, exceeding requirements of Commercial, Standard class.
 - b. Size: Elongated.
 - c. Hinge Type: Self-sustaining check (SC).

3.9 URINAL SCHEDULE

A. Urinal: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Vitreous-China Urinal:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. Zurn Plumbing Products
3. Flushometer Valve:
 - a. American Standard.
 - b. Sloan Valve Co.
 - c. Zurn Industries, Inc.; Flush Valve Operations.
4. Flushometer Valve Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, and vacuum breaker.
5. Flushometer Valve Operation: Diaphragm.
6. Flushometer Valve Finish: Polished, chrome-plated, exposed metal parts.
7. Flushometer Valve, Water Consumption: Factory set 0.5 gal. maximum per flushing cycle.
8. Flushometer valve components include the following:
 - a. Brass, lever-handle actuation.
 - b. Non-hold-open feature.
9. Fixture Support: Type II, concealed arm; vertically adjustable, chair carrier with heavy-duty, rectangular-steel, upright members; and feet

3.10 LAVATORY SCHEDULE

- A. Lavatory: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
1. Products: Subject to compliance with requirements, provide one of the following:
 2. Vitreous-China Lavatory:
 - a. American Standard, Inc.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - d. Zurn Plumbing Products
 3. Faucet:
 - a. American Standard, Inc.
 - b. Chicago Faucet Co.
 - c. Kohler Co.
 - d. T & S Brass and Bronze Works, Inc.
 - e. Zurn Industries

4. Fitting Insulation Kit:
 - a. TRUEBRO, Inc.
 - b. McGuire
 - c. Brocar
5. Supplies: See Fittings section of this specification.
6. Faucet Construction: Cast brass with ceramic cartridges and polished chrome finish.
7. Faucet Water Consumption: As specified on drawings.
8. Supply Insulation Kit: Molded, soft-plastic covering for supplies from wall to fixture with removable covering for stops and handles. Include manufacturer's standard fasteners, straps, and adhesives.
9. Drain Insulation Kit: Molded, soft-plastic covering for drain piping from fixture to wall. Include manufacturer's standard fasteners, straps, and adhesives.
10. Fixture Support: Type II, concealed arm; vertically adjustable, chair carrier with heavy-duty, rectangular-steel, upright members; and feet.

3.11 SHOWER SCHEDULE

- A. Shower: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Antiscald Faucet:
 - a. Lawler Manufacturing Co., Inc.
 - b. Leonard Valve Co.
 - c. Powers Process Controls.
 - d. Symmons Industries, Inc.
 - e. Zurn
3. Mixing-Valve Faucet and Miscellaneous Fittings:
 - a. Leonard Valve Co.
 - b. Powers Process Controls.
 - c. Symmons Industries, Inc.
 - d. Zurn
4. Fixture Enclosure Grab Bar: Factory fabricated. Field installed.
5. Faucet Construction: Cast-brass, pressure-equalizing-control with high-temperature-limit control, single-handle mixing valve with check stops, and escutcheon.
6. Faucet Components: Include the following:
 - a. Handle{s}: Single-lever, chrome-plated brass.
 - b. Shower Head, Arm, and Flange: Manufacturer's standard with manual flow control in head.
 - c. Shower Arm, Flow-Control Fitting: 2-1/2 gpm.
 - d. Hand Shower, Hose, and Brackets or Slide: Manufacturer's standard.
 - e. Hose-Supply, Flow-Control Fitting: 2-1/2 gpm.

7. Supplies: Copper tubing with ball, gate, or globe valve if check stops not included with faucet.
8. Trap: 2-inch NPS drainage piping.

3.12 SINK SCHEDULE

- A. Accessible: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the Drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Stainless-Steel Sink:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Co.
 - c. Advance Tabco
3. Faucet:
 - a. American Standard, Inc.
 - b. Chicago Faucet Co.
 - c. Kohler Co.
 - d. T&S Brass and Bronze Works, Inc.
 - e. Zurn Industries
4. Fitting Insulation Kit:
 - a. TRUEBRO, Inc.
 - b. McGuire
 - c. Brocar
5. Fixture Stainless-Steel Thickness: 18 gauge.
6. Fixture Mounting: Counter, self-rimming.
7. Faucet Construction: See Fixture Schedule for faucet styles.
8. Faucet Water Consumption: 2.0 gpm maximum flow.
9. Drain{s}: 1-1/2-inch removable, stainless-steel strainer bucket with 3-1/2-inch removable, stainless-steel crumb cup with 1-1/2-inch NPS tubular-brass tailpiece.
10. Supplies: See Fittings section of this specification.

3.13 MOP-SERVICE BASIN SCHEDULE

- A. Mop-Service Basin: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
1. Products: Subject to compliance with requirements, provide one of the following:

2. Mop-Service Basin:
 - a. Fiat Products, Inc.
 - b. Forestone
 - c. Stern-Williams Co., Inc.
3. Faucet:
 - a. American Standard, Inc.
 - b. Chicago Faucet Co.
 - c. Delta Faucet
 - d. Kohler Co.
 - e. Speakman Co.
 - f. T & S Brass and Bronze Works, Inc.
 - g. Zurn Industries
4. Fixture Dimensions: See Plumbing Fixture Schedule on drawings.
5. Mounting: Floor.
6. Rim Guard: Manufacturer's standard.
7. Faucet: Widespread, cast brass with supplies on 8-inch centers.
8. Faucet Mounting: Wall, centered on fixture.
9. Faucet Components: Include the following:
 - a. Finish: Rough chrome.
 - b. Handles: Dual lever or 4 arm.
 - c. Supply Stops: Integral, in shanks.
 - d. Spout: With integral vacuum breaker, pail hook, and hose-thread outlet.
 - e. Wall Brace: Assembly with wall bracket and support to faucet spout.
 - f. Hose: 30-inch-minimum, flexible hose with stainless-steel hose wall bracket.
10. Drain: 3-inch NPS with grid strainer.
11. P-Trap: 3-inch NPS drainage piping.
12. Supplies: 1/2-inch NPS copper tubing with supply stop.
13. Reinforcement: Provide for wall-mounting faucet, wall brace, and hose-hook bracket.

3.14 ELECTRIC WATER COOLER SCHEDULE

- A. Electric Water Cooler: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Acorn Aqua; Acorn Mfg. Co.
 - b. Elkay Manufacturing Co.
 - c. Halsey Taylor.
 - d. Haws Drinking Faucet Co.
 - e. Oasis

2. Fixture Type: Bubbler.
3. No. of Bubblers or Stations: One.
4. Fixture Cabinet Material: Stainless steel.
5. Fixture Mounting: Wall.
6. Wall Grille: Stainless steel.
7. Supply: 3/8-inch NPS copper tubing with supply stop.

3.15 EMERGENCY EQUIPMENT SCHEDULE

- A. Emergency Eyewash: Emergency Shower: Where plumbing fixtures of this designation are indicated, provide products complying with the following and with the Plumbing Fixture Schedule on the drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bradley Corp.
 - b. Guardian Equipment.
 - c. Haws Drinking Faucet Co.
 - d. Speakman Co.
 - e. Western Emergency Equipment.
2. Mounting: Wall. Floor, with wall brace.
3. Supply: 1/2-inch NPS 1-inch NPS 1-1/2-inch NPS copper tubing.
4. Drain: Manufacturer's standard.
5. Trap: 1-1/4-inch NPS, 17 ga. chrome plated, cast brass P-trap, pipe nipple to wall and wall flange.

3.16 EQUIPMENT FURNISHED BY OTHER DIVISION

- A. Fixture Equipment: Where plumbing fixtures of this designation are indicated and provide products complying with the following and with the drawings:

1. Products: Subject to compliance with requirements, provide one of the following:
2. Supply Inlet: 1/2-inch NPS
3. Supply Stop: Globe or ball valve.
4. Supply Riser: Rigid copper supply, size as determined by equipment inlet.
5. Drain: Connect to equipment drain outlet and route drain piping to drain receptor. Use DWV copper piping and fittings. Make indirect connection at drain receptor unless noted otherwise.

END OF SECTION 224000

SECTION 230000 - GENERAL HVAC PROVISIONS

PART 1 - GENERAL

1.1 Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes general provisions covering the contract documents for HVAC Systems.

1.3 DEFINITIONS

- A. Provide shall mean "Furnish, install and connect."
- B. Piping shall mean "pipe installed with all specified fittings, valves and accessories, and forming a complete system."
- C. HVAC shall mean "Heating, Ventilation and Air Conditioning."

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Electrical Coordination: In addition to submittal requirements of other Division 23 Sections, submit a document approved by the project Electrical Contractor certifying that all mechanical equipment being furnished under Division 23 complies with the electrical characteristics of the source power which will be furnished under Division 26.
- C. Model numbers listed on the Mechanical Contract Documents shall not be construed to indicate electrical characteristics. Electrical characteristics of mechanical equipment shall be as indicated on the Electrical Contract Documents (Division 26).
- D. Review of Submittals does not relieve the Contractor of any of the requirements of the Contract Documents. Failure by the Engineer to document errors and omissions in the Contractor's submittals during the Engineer's submittal review does not constitute a waiver of any of the requirements of the original Contract Documents.

1.5 CONTRACTOR QUALIFICATIONS

- A. HVAC Subcontractor shall have a current Class II Conditioned Air Contractors License for the state in which the project is being constructed. The Subcontractor shall have as part of the Firm a Service Department qualified to service all systems installed in the project or have a written agreement with a Service Agency qualified to provide such service. The Service Department or Agency shall be on call at all hours. The subcontractor shall have installed at least (within the last five years):

1. One heat recovery variable refrigerant flow system of at least 20-tons in size.

1.6 PRIOR APPROVALS

- A. Manufacturers References: When reference is made in the Contract Documents to trade names or specific manufacturers and/or models, such reference, unless noted otherwise, is made to designate and identify the quality of materials or equipment to be furnished and is not intended to restrict competitive bidding. If it is desired to use materials or equipment different from those indicated on the Contract Documents, written request for approval must reach the hands of the Design Professional at least TEN DAYS prior to the date set for the opening of bids. A copy of the request should also be sent directly to the Engineer. Requests for prior approval of a proposed substitute shall be accompanied by complete technical data supporting the request.
- B. Request for Prior Approval by facsimile transmission (fax) or email will not be considered. Prior approval requests shall be submitted in hard copy format only.

1.7 LAYOUT AND COORDINATION

- A. Layout Basis:
 1. The equipment listed on the Drawings and in the Specifications has been used for the physical arrangement of the mechanical systems. When equipment listed as acceptable, equal or equipment which has received "prior approval" is used, it shall be the Contractor's responsibility to provide structural, ductwork, electrical, service clearances, or other changes required to accommodate the substituted equipment. Changes shall be made at no additional cost to the Owner. Submit a list of required changes along with all prior approval requests and shop drawing submittals.
 2. The Contract Drawings are intended to show the general arrangement of all mechanical work. They do not show in detail all offsets, fittings and transitions. Examine Drawings, investigate site conditions to be encountered and arrange work accordingly. Furnish all offsets and transitions required.
 3. Drawings do not indicate in detail exact configuration of connections for fixtures, equipment and accessories. Final connection shall be as shown on approved Manufacturer's Submittal Drawings. Where Manufacturer's Submittal Drawings conflict with the Contract Documents, confer with the Design Professional for resolution.
 4. Measurement of Drawings by scale shall not be used as dimensions for fabrication. Measurements for locating fixtures, equipment, ductwork, piping and other mechanical items shall be made on the site and shall be based on actual job conditions.
 5. Check space limitations and verify electrical requirements before ordering any mechanical equipment or materials. Place large equipment inside the building prior to the erection of exterior walls where equipment cannot enter finished building openings.
- B. Coordination: Mechanical work shall be coordinated with that of other trades to avoid conflict. The Contractor shall study all plans and specifications for this project and shall notify the Design Professional of any conflict between work under Division 23 and work under other divisions of the Project. Particular attention shall be given to interference between piping, electrical installations, structural systems, building openings and ductwork.

- C. Installation Instructions: Two binders containing manufacturer's installation instructions for all equipment furnished under Division 23 shall be furnished by the Contractor. One binder shall be kept in the General Contractor's office at the job site. The other binder shall be delivered to the Engineer upon acceptance by the Design Professional of the Submittals.
- D. Operation and Maintenance Instructions: Three copies of equipment O&M manuals contained in rigid 3-ring binders shall be submitted to the Owner a minimum of 15 days prior to equipment/systems training. Binders shall have permanent labels on the spine and front cover indicating project name, project number, building name and contents. Model and serial numbers of equipment shall be shown on the cover of their respective O&M manual(s).

1.8 PERMITS

- A. Obtain all necessary Permits and Inspections required for the installation of this work and pay all charges incident thereto. Deliver to the Design Professional all certificates of inspection issued by authorities having jurisdiction.
- B. Sewer tap fees, water tap fees, meter fees, Dept. of Labor Fees for Boilers and Pressure Vessels and all other charges for work under Division 23, including charges for meter installation and excess service by the Gas Company or any other utilities shall be paid by the Contractor.

1.9 SAFETY

- A. OSHA Requirements applicable to the project shall be complied with at all times.
- B. Manufacturer's Safety Instructions shall be followed in all instances.
- C. Asbestos Containing Materials (ACM) shall not be used on this project.
- D. Refrigerants containing CFC's or HCFS's shall not be used on this project, nor shall any equipment using such refrigerants be incorporated into this project.
- E. Electrical Equipment Clearances: Piping, equipment and other mechanical installations shall not be located within 42" of the front or 36" of the side of any electrical switchboards, panelboards, power panels, motor control centers, electrical transformers or similar electrical equipment. Piping and ductwork shall not pass through or above electrical equipment rooms except as required to serve those rooms.
- F. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof or grade below. The guard shall extend not less than 30 inches beyond each end of such appliances, equipment, fans, components and roof hatch openings and the top of the guard shall be located not less than 42 inches above the elevated surface adjacent to the guard. The guard shall be constructed so as to prevent the passage of a 21 inch diameter sphere and shall comply with the loading requirements for guards specified in the International Building Code.

1.10 PROTECTION OF MECHANICAL SYSTEMS AND COMPONENTS DURING CONSTRUCTION

A. Material storage:

1. All materials and equipment stored on the jobsite shall be elevated above the ground and stored under suitable weather cover. Materials and equipment shall not be situated in areas subjected to localized flooding.
2. Manufacturer's original shipping packaging and protective coverings shall be left in place until the equipment is prepared for installation.

B. Roof protection: All penetrations through roofs, including roof curbs, piping curbs and roof drainage system elements shall be properly protected during construction to prevent water intrusion into the building. Protective measures could include temporary covers and plugs, as well as other appropriate temporary elements.

C. Electrical enclosure protection:

1. During construction, all protective covers and other devices shall be left in place that protect against inadvertent contact with live electrical circuits.
2. All warning labels related to electrical and rotating equipment hazards shall be in place prior to energizing mechanical equipment circuits.

D. Protection of ducts and piping

1. Maintain temporary closures on the ends of all ducts and pipes as the installation work progresses. Temporary closures include plastic sheeting, tape and appropriate caps and covers.
2. Where debris enters piping during installation, steps shall be taken to clean the interior of the pipe prior to placing in service.
3. Where debris enters ductwork during installation the duct interior shall be cleaned prior to placing in service.

E. Operation of HVAC systems during construction

1. Although the operation of the permanent HVAC systems during the construction process is strongly discouraged, the Contractor shall take measures to protect the systems from contamination if they are operated.
2. When placed in operation during the construction period, all HVAC systems shall have MERV 8 filtration in all standard filter racks throughout the systems. Where so equipped, final filter banks do not have to be in place.
3. All return and outdoor air intake openings shall be protected with MERV 8 filter material at all points of entry into the duct system. These protections shall be maintained and remain in place until the building is prepared for final inspection.
4. Prior to final acceptance of the building HVAC systems, the interior of all HVAC unit cabinets shall be thoroughly cleaned to "like-new" condition.

1.11 CODES AND STANDARDS

- A. Mechanical installations shall conform to the current edition of the following, in addition to any previously mentioned Codes and Standards.

1. The International Building Code.
2. The International Mechanical Code.
3. The International Plumbing Code.
4. The International Fire Protection Code.
5. The State Energy Code.
6. NFPA Standard 70, National Electric Code.
7. NFPA Standard 90A, Installation of Air Conditioning and Ventilation Systems.
8. NFPA Standard 101, Code for Safety to Life for Fire in Buildings and Structures.

1.12 INTERRUPTION OF EXISTING SERVICES

- A. Exercise care so as not to cut any existing utilities or services. Where an existing utility line or service line is cut it shall be repaired to "like-new" condition. Interruption of service shall not be made without prior written permission of the Owner.
- B. Plumbing, Electrical and HVAC system must remain in service during construction. Arrange with the Owner well in advance of shutdowns required for tie-ins. Shutdowns shall be made after normal occupancy hours if so directed by the Owner. No additional monies will be paid for after-hours shutdowns.

PART 2 - PRODUCTS Not required for this section.

PART 3 - EXECUTION Not required for this section.

END OF SECTION 230000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Labeling and identifying mechanical systems and equipment is specified in Division 23.
 - 5. Nonshrink grout for equipment installations.
 - 6. Field-fabricated metal and wood equipment supports.
 - 7. Installation requirements common to equipment specification Sections.
 - 8. Mechanical demolition.
 - 9. Cutting and patching.
 - 10. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for following piping specialties:
 - 1. Identification materials and devices.
- C. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- D. Coordination drawings for access panel and door locations.
- E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.
- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- E. Coordinate all electrical service requirements for mechanical equipment prior to the submittal of shop drawings. Confirm the compatibility of all power services with the equipment being furnished. Confirm compatibility of electrical lugs being provided by the equipment manufacturer with the power wiring being furnished under Division 26. Furnish written documentation that all characteristics have been coordinated with and confirmed by the electrical subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 23 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch minimum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
 - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
 - 3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- E. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
 - 1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
 - 2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
 - 3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
 - 4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.

B. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

C. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.

- a. Penetrating Pipe Deflection: 5 percent without leakage.
 - b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
 - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.
5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
- a. Underdeck Clamp: Clamping ring with set-screws.

D. Piping Roof Curbs:

1. Curb and cap shall be constructed of minimum 18-gauge galvanized sheet metal with continuous welded seams.
2. Provide cant-strip at the base of curb for flashing.
3. Line curb with 1½-inch fiberglass insulation.
4. Galvanized sheet metal cap shall have welded sheet metal collars (sleeves) for each pipe that allow for installation of insulated pipe.
5. Seal annular space between pipe/insulation and collar with a flexible weatherproof boot and stainless-steel pipe clamps.
6. Cap shall be secured to the curb nailer with cadmium plated screws; minimum one per side.

2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 2. Location: An accessible and visible location.
- C. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- D. Valve Tags: Engraved brass numbered tags on steel chain.
- E. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine sub-core, except when other colors are indicated.
1. Fabricate in sizes required for message.

2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 3. Punch for mechanical fastening.
 4. Thickness: 1/16 inch, except as otherwise indicated.
 5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.
- F. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

- A. Non-shrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

2.6 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide UL Listed firestopping system for filling openings around penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products: Subject to compliance with requirements, provide products by one of the following:
1. Specified Technologies, Inc.
 2. 3M Corporation
 3. Metacaulk.
 4. Hilti, Inc.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 23 specify piping installation requirements unique to the piping system.

- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.
- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, exterior walls and where indicated.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6 inches.
 - b. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
 - c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."
 - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation in non-rated floors and partitions, using elastomeric joint sealants. EXCEPTION: Fire rated partition penetrations shall be sealed with U.L. Listed firestopping systems.
- N. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and elastomeric sealant. Size sleeve for ½-inch annular clear space between pipe and sleeve for installation of sealant.
1. Install steel pipe for sleeves smaller than 6 inches.
 2. Install sheet metal sleeve assembly for sleeves 6 inches and larger.
 3. Install cast iron sleeves according to manufacturer's preprinted instructions.
- O. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
- P. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
- Q. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with U.L. Listed firestopping sealant system.
- R. Verify final equipment locations for roughing in.
- S. Refer to equipment specifications in other Sections for roughing-in requirements.
- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
 4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
 8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
 - a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
 - b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
 - c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
 - d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
 - e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
 - f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.
 9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.
 - a. Plain-End Pipe and Fittings: Butt joining.
 - b. Plain-End Pipe and Socket-Type Fittings: Socket joining.
- U. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
 2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 3. Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Design Professional.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.
- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

- E. Install equipment giving right-of-way to piping systems installed at a required slope.
- F. Equipment and appliances containing evaporators or cooling coils shall be installed with a means of condensate removal in compliance with IMC 307.2. A water level detection device conforming to UL 508 shall be provided for all main condensate pans and be interlocked to de-energize the unit's main fan should the drain pan water level exceed the main drain pipe connection level. Additional measures shall be taken where indicated on drawings or specifications.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Stenciled Markers: Complying with ASME A13.1.
 - 2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot non-insulated pipes.
 - 3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - 4. On piping above removable acoustical ceilings, provide as noted in the previous paragraph, except omit intermediately spaced markers.
- B. Valves: Provide tags on all valves provided under the project. Furnish a typed list of all tags to the Owner at project closeout.
- C. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

- D. Mark all above ceiling devices such as valves, fire dampers, pumps and HVAC equipment with signs located on the ceiling below.
- E. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
 - 1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
- F. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

- A. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Paint all exposed steel surfaces of piping and supports with one coat of primer and two coats of enamel.

3.5 CONCRETE BASES

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete with 6 x 6 x #10 reinforcing wire mesh. Outdoor concrete bases shall extend a minimum of 4" above grade and be a minimum thickness of 6".

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.9 GROUTING

- A. Install nonmetallic non-shrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230500

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawing and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Product data for each type of hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
- C. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 1. Components include galvanized coatings or alternate rust preventing shop coating.
 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, non-shrink, nonmetallic.
 1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is non-staining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.

3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

- K. Support all piping direct from structure and independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on insulated piping. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

<u>NPS (Inches)</u>	<u>LENGTH (Inches)</u>	<u>THICKNESS (Inches)</u>
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105
 - 4. Pipes 6 Inches and Larger: Include shield inserts.
 - 5. Insert Material: Length at least as long as the protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
- C. Paint all exposed steel surfaces with one coat of primer and two coats of enamel.

END OF SECTION 230529

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring electrical performance of HVAC equipment.
 - 4. Setting quantitative performance of HVAC equipment.
 - 5. Verifying that automatic control devices are functioning properly.
 - 6. Measuring sound and vibration.
 - 7. Reporting results of the activities and procedures specified in this Section.
- B. Related Sections include the following:
 - 1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
 - 2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.

- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.
- C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.
- D. Certified Testing, Adjusting, and Balancing Reports: Submit 3 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

- E. Sample Report Forms: Submit 3 sets of sample testing, adjusting, and balancing report forms.
- F. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Design Professional's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. Contract Documents examination report.
 - c. Testing, adjusting, and balancing plan.
 - d. Work schedule and Project site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards or in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- G. Test and balance process is not deemed as accepted until a complete report is received free of deficiencies and discrepancies and approved in writing by the Engineer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Material Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Furnish one of the following:
 - 1. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents.
 - 2. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents.
 - 3. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 4. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

2. Verify that balancing devices are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine project record documents.
- D. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- F. Examine system and equipment test reports.
- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Review manufacturer's certification for each piece of HVAC equipment to be tested. Test and balance shall not be performed until certification letters have been obtained.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine equipment for installation and for properly operating safety interlocks and controls.
- N. Examine automatic temperature system components to verify the following:
 1. Dampers, valves, and other controlled devices operate by the intended controller.
 2. Dampers and valves are in the position indicated by the controller.
 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.

5. Thermostats and sensors are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to design values.
- O. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 5. Isolating and balancing valves are open and control valves are operational.
 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 7. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or AABC National Standards and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity (if necessary).
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Measure static pressures entering and leaving other devices such as duct silencers under final balanced conditions.
 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 5. Adjust fan speed higher or lower than design with the approval of the Design Professional. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using standard measurement practices.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- F. Measure outdoor air flow minimum requirement damper settings as scheduled with controls contractor. Document voltage settings of control damper actuator in the minimum cfm position. For

units with CO₂ controls, measure outdoor air flow maximum requirement settings as scheduled with controls contractor. Document voltage setting of control damper actuator in the maximum cfm position. Controls contractor shall provide on-site technical support to modulate outside air damper min/max position with test and balance contractor to accomplish min/max cfm settings for proper unit operation.

3.6 BI-POLAR IONIZATION UNITS

- A. Confirm operation of bi-polar ionization units, where installed, using an ion counter meter. Report any non-conforming units.

3.7 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating if high-efficiency motor.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.8 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.9 HEAT-TRANSFER COILS

- A. Dx Coils: Measure the following data for each coil:
 - 1. Dry-bulb temperatures of entering and leaving air.
 - 2. Wet-bulb temperatures of entering and leaving air (for cooling coils).
 - 3. Airflow.
 - 4. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperatures at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.

5. Calculated kW at full load.
6. Fuse or circuit-breaker rating for overload protection.

3.10 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 FUME HOODS

- A. Determine total airflow into the room where the fume hood is located and balance systems to ensure adequate air supply to all hoods.
 1. Set fume-hood door opening at position of normal use.
 2. Energize the exhaust fan and adjust airflow to provide the indicated average fume-hood face velocity at hood opening.
 3. Measure exhaust airflow volume by measuring airflow by Pitot-tube duct traverse.
 4. Measure air velocity using Pitot-tube traverse method.
 5. Record each face velocity measurement taken at 4- to 6-inch increments over the entire hood door opening.
 6. Calculate the average face velocity by averaging all velocity measurements.
 7. Calculate the airflow volume of exhaust-hood face velocity by multiplying the calculated average face velocity by the opening area. Compare this quantity with exhaust volume at exhaust fan and report duct leakage.
 8. Measure airflow volume supplied by makeup fan. Verify that the makeup system supplies the proper amount of air to keep the space at the indicated pressure with the exhaust systems in all operating conditions.
 9. Retest for average face velocity. Adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity and the indicated auxiliary air-supply percentages.
 10. Retest and adjust the systems until fume-hood performance complies with Contract Documents.

3.12 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.

- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.13 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: Minus 10 percent to plus 10 percent.
 - a. In spaces that are to have positive pressure relationship to adjacent spaces, the overall space tolerances for supply airflow shall be 0 to plus 10 percent and return/exhaust airflow shall be 0 to minus 10 percent.
 - b. In spaces that are to have a negative pressure relationship to adjacent spaces, the overall space tolerances for supply airflow shall be 0 to minus 10 percent and return/exhaust airflow shall be 0 to plus 10 percent.

3.14 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
 - 2. Include letters from HVAC equipment manufacturers certifying that each piece of equipment has been installed and commissioned in accordance with manufacturer's recommendations.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: Perform testing, adjusting, and balancing procedures during near-peak summer (above 85°F) and during near-peak winter conditions (below 40°F.) Retainage may be held until each season has been tested. Refer to contract documents.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe, duct, and equipment insulation.

1.3 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal resistivity is designated by an r-value that represents the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivity (r-value) is expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU per hour to flow through 1 square foot at mean temperatures indicated.
- E. Thermal Conductivity (k-value): Measure of heat flow through a material at a given temperature difference; conductivity is expressed in units of Btu x inch/h x sq. ft. x deg F.
- F. Density: Is expressed in lb./cu.ft.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping and duct systems.
- B. Schedule insulation application after installation and testing of heat trace tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Glass Fiber:
 - a. CertainTeed Corporation.
 - b. Knauf Fiberglass GmbH.
 - c. Manville.
 - d. Owens-Corning Fiberglas Corporation.
 - e. USG Interiors, Inc. - Thermafiber Division.
 2. Flexible Elastomeric Cellular:
 - a. Armaflex; Armacell LLC
 - b. K-Flex; Nomaco K-Flex Corporation.
 - c. Aerocel; Aeroflex USA, inc.

2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.
 1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
 2. Density: 3 pcf minimum.

- D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.
1. Thermal Conductivity: 0.32 Btu x inch/h x sq. ft. x deg F average maximum, at 75 deg F mean temperature.
 2. Density: 3/4 pcf minimum within building envelope.
 3. Density: 1 pcf minimum exterior to building envelope.
- E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
1. Thermal Conductivity: 0.26 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F mean temperature.
 2. Density: 3 pcf minimum.
- F. Adhesive: Produced under the UL Classification and Follow-up service.
1. Type: Non-flammable, solvent-based.
 2. Service Temperature Range: Minus 20 to 180 deg F.
- G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

- A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
1. Tubular Materials: ASTM C 534, Type I.
 2. Sheet Materials: ASTM C 534, Type II.
- B. Thermal Conductivity: 0.25 Btu x inch/h x sq. ft. x deg F average maximum at 75 deg F.
- C. Coating: Water based latex enamel coating recommended by insulation manufacturer.
- D. Fire Performance Characteristics: Provide material having the following fire performance characteristics as determined by UL in accordance with ASTM Standard E84:

Flame Spread = 25

Smoke Developed = 50

2.4 INSULATING CEMENTS

- A. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
1. Thermal Conductivity: 1.2 Btu x inch/h x sq. ft. x deg F average maximum at 400 deg F mean temperature.
 2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
 - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
 - 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
 - 1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
 - 2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.
- C. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes.
 - 1. Finish and Thickness: Smooth finish, 0.010 inch thick.
 - 2. Moisture Barrier: 1 mil, heat-bonded polyethylene and kraft paper.
 - 3. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

2.7 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
 - 1. Tape Width: 3 inches.
 - 2. Cloth Standard: MIL-C-20079H, Type I.
 - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: Type 304, 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.01 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.

- C. Wire: 14 gage nickel copper alloy, 16 gage, soft-annealed stainless steel, or 16 gage, soft-annealed galvanized steel.
- D. Corner Angles: 28 gage, 1 inch by 1 inch aluminum, adhered to 2 inches by 2 inches kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.8 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
 - 1. Water Vapor Permeance: 0.08 perm maximum.
 - 2. Temperature Range: Minus 20 to 180 deg F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
 - 1. Water Vapor Permeance: 0.02 perm maximum.
 - 2. Temperature Range: Minus 50 to 250 deg F.
 - 3. Color: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
 - 1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.
- H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
 - 1. Factory-insulated flexible ducts.
 - 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 3. Flexible connectors for ducts and pipes.
 - 4. Vibration control devices.
 - 5. Testing laboratory labels and stamps.
 - 6. Nameplates and data plates.
 - 7. Preinsulated access panels and doors in air distribution systems.
 - 8. Sanitary drainage and vent piping. (Drainage piping receiving air conditioning condensate shall be insulated.)
 - 9. Below grade piping.

3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
 - 3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. 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 on center.

- a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
 4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
 6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.
- G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.
- H. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.
- I. Wall and Partition Penetration: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- J. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with a U.L. Listed firestopping or fire-resistant joint sealer.
- K. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.
- L. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply pre-molded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
1. Use same material and thickness as adjacent pipe insulation.
 2. Overlap nesting insulation by 2 inches or 1-pipe diameter, which ever is greater.
 3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
 4. Insulate elbows and tees smaller than 3 inches pipe size with pre-molded insulation.
 5. Insulate elbows and tees 3 inches and larger with pre-molded insulation or insulation material segments. Use at least 3 segments for each elbow.
 6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.

- M. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 23 Section "Hangers and Supports."

3.4 BELOW GROUND PIPE INSULATION INSTALLATION

- A. See individual piping sections.

3.5 GLASS FIBER PIPE INSULATION INSTALLATION

- A. Bond insulation to pipe with lagging adhesive.
- B. Seal exposed ends with lagging adhesive.
- C. Seal seams and joints with vapor barrier compound.

3.6 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

- A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.
 - 1. Miter cut materials to cover soldered elbows and tees.
 - 2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.7 DUCT INSULATION

- A. Install block and board insulation as follows:
 - 1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
 - 2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.
- B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
 - 1. Smaller Than 24 Inches: Bonding adhesive applied in 6 inches wide transverse strips on 12 inches centers.

2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
3. Overlap joints 3 inches.
4. Seal joints, breaks, and punctures with vapor barrier compound and glass tape (glasfab and mastic).

3.8 JACKETS

- A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2 inches laps at longitudinal joints and 3 inch wide butt strips at end joints.
 1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound (mastic) and glass tape (glassfab).
- B. Interior Exposed Insulation: Install continuous aluminum jackets.
- C. Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.
- D. Install metal jacket with 2 inches overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.
- E. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2 inch overlap at joints. Embed glass cloth between (2) 1/16 inch thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

3.9 FINISHES

- A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed exterior insulation.

3.10 APPLICATIONS

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Piping Systems: Unless otherwise indicated, insulate the following piping systems:
 1. Air conditioning condensate drains and sanitary P-traps receiving air conditioning condensate.
 2. Refrigerant suction and hot gas piping.
 3. All refrigerant piping used for split systems with inverter-outdoor units (i.e. mini-splits, ductless split systems.)
 4. All refrigerant piping used for variable refrigerant volume systems.

C. Duct Systems: Unless otherwise indicated, insulate the following duct systems:

1. Supply, return and outside air ductwork. (Except double-wall spiral duct exposed in occupied building spaces.)
2. Above-ceiling surfaces of all air devices except where pre-insulated.
3. Interior exposed supply, return and outside air ductwork.
4. Exterior exposed supply and return ductwork.
5. Relief ductwork between air inlet devices and energy recovery units.
6. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.

3.11 PIPE INSULATION SCHEDULES

A. General: Furnish insulation vapor barrier on all piping carrying fluids below 60°F.

B. Schedules:

1. Refrigerant Suction and Hot Gas Piping: 3/4" flexible elastomeric insulation. Paint exterior insulation with two coats of manufacturer recommended coating or polymeric pipe covering as recommended by the manufacturer.
2. All refrigerant piping used for split systems with inverter driven outdoor units (i.e. mini-splits, ductless split systems): 3/4" flexible elastomeric insulation. Paint exterior insulation with two coats of manufacturer's recommended coating
3. All refrigerant piping used for variable refrigerant volume systems: 3/4" flexible elastomeric insulation. Paint exterior insulation with two coats of manufacturer's recommended coating.
4. Air Conditioning Condensate Drain and Humidifier Drain Piping: 3/8" flexible elastomeric insulation (interior applications only).
5. Domestic Makeup Water Piping (interior): 3/4" flexible elastomeric insulation.

3.12 DUCTWORK AND PLENUM INSULATION SCHEDULES

A. General: Furnish vapor barrier on all ductwork insulation.

B. Schedules:

1. Interior Supply, return, and relief ductwork between air inlet devices and energy recovery units, and outdoor air ductwork
 - a. Lined and unlined within building envelope: 2" glass fiber blanket. Seal all joints and penetrations in jacket with glasfab and mastic.
 - b. Outside Building Envelope: 3" glass fiber blanket or board.
2. Exterior Supply, return, and relief ductwork between air inlet devices and energy recovery units, and outdoor air ductwork (lined and unlined): 2" glass fiber board with aluminum jacket.
3. Supply, Return, and Outdoor Air Ductwork (lined and unlined) Exposed in Mechanical Rooms: 2" glass fiber board.

3.13 INSULATION EXPOSED IN MECHANICAL ROOMS:

- A. Finish all piping, equipment and ductwork insulation exposed in each mechanical room with a field applied 8 ounce per square yard canvas jacket cemented in place with white lagging adhesive.
- B. Apply PVC pipe fitting covers over canvas.
- C. Paint canvas with two coats of enamel paint. Colors shall be approved by the Design Professional. Piping insulation shall be painted in accordance with the Owner's color scheme.

END OF SECTION 230700

SECTION 230900 - CONTROL SYSTEMS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes control equipment for HVAC systems and components.
- B. Related Section: Division 23 Section "Sequence of Operation" contains requirements that relate to this Section.

1.3 SYSTEM DESCRIPTION

- A. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multitasking, multiuser network and programmed to operate mechanical systems according to sequences of operation indicated or specified.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: VRF and Dedicated Outdoor Air Unit control systems shall be provided by unit manufacturer.

2.2 THERMOSTATS

- A. See individual equipment sections.

PART 3 – EXECUTION Not required for this section.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems and terminal units.
- B. Related Section: Division 23 Section "Control Systems Equipment" contains requirements that relate to this Section.

1.3 SAFETY AND RELIABILITY SYSTEMS:

- A. Smoke (or Combination) Damper/Smoke Detector: Upon sensing smoke at the detector, the damper shall close. When the damper is closed, the indicator light shall illuminate on the ceiling below the damper.
- B. Upon any fan system (i.e. air handling unit, exhaust fan) shutdown, all smoke dampers (or combination smoke/fire dampers) in that fan system's duct system shall close. Coordinate damper closure sequence/fan system shutdown with fire alarm system contractor. Fan restart shall require damper end switch proof of opening in order to reenergize fan(s). (Engineer note – certain specialty areas may require dampers to stay open as part of a smoke control sequence, or to close without shutting down the ahu system.)
- C. Auto Restart: All HVAC systems and equipment shall be configured such that normal operation is resumed after a power failure.
- D. Dead Band: Where used to control both heating and cooling, zone thermostats shall be capable of providing a temperature dead band of at least 5°F in accordance with ASHRAE standard 90.1.
- E. Setback/Overrides:
 - 1. All HVAC systems/units shall be scheduled for operation by the DDC system. The occupancy schedule shall be prescribed by the Owner.
 - 2. In unoccupied mode, the temperature setpoint shall be set back to 50°F for heating 85°F for cooling. Unit supply fans shall run only as required to maintain setback temperatures. The DOAS shall not operate, outdoor air dampers shall be closed, and exhaust fans shall not operate.
 - 3. Prior to the occupancy period, the HVAC systems shall energize to cool or warm the spaces to normal occupied setpoint. The DOAS shall not energize, outdoor air dampers shall remain closed, and exhaust fans shall remain off during warmup/cool-down.

4. The DOAS shall only operate, outdoor air dampers shall open to setpoint, and general exhaust fans shall energize only when setpoint is reached and the building is in occupied mode.
5. Individual HVAC systems shall be equipped with override buttons on the unit thermostats. When the button is activated, the unit shall operate in occupied mode for a period determined by the Owner.

1.4 CENTRAL PLANT SYSTEMS

A. Variable Refrigerant Flow (VRF) Systems:

1. The sequence of operation for VRF systems shall be in accordance with the system manufacturer's requirements, utilizing controllers furnished as part of the system.
2. In general, indoor heat pump units shall provide heat or cooling in response to their individual thermostat/controller.
3. The central system shall coordinate the operation of the outdoor and indoor units to provide for space temperature control, refrigerant flow control and compressor operation.
4. The VRF system controls shall be integrated into the FMS via a BacNet interface.

1.5 UNITARY SYSTEMS

A. Heat Pump Units:

1. Units shall be controlled by room thermostats.
2. Runtime of the unit shall be scheduled by the FMS. During unoccupied mode, outside air damper shall be closed (where applicable.)
3. When unit is scheduled to run, the compressor, heat/cool reversing valve and supply fan shall energize in heating or cooling mode as required to satisfy the thermostat setpoint.
4. When the compressor is unable to meet the heating requirements, the auxiliary strip heat shall energize.
5. Where systems are designated to utilize CO² based ventilation controls, outdoor damper shall modulate from the minimum position to the maximum position when the return air CO² level exceeds 900 ppm.
6. When outdoor air temperature is above 45°F (adj), resistance heat shall not be energized.

B. Split Systems (ductless):

1. Split systems shall be controlled by individual thermostats furnished by the manufacturer. Heating or cooling shall be energized as required to maintain space temperature.
2. The system serving the Dietitians Office shall be scheduled by the FMS. The system serving the Dry Goods Storage Room, MDF and IDF Rooms shall be enabled continuously.
3. DDC temperature sensors shall be used for monitoring and alarm.

C. Wall Mounted Heat Pumps:

1. Units shall be controlled by the DDC heat pump thermostat.
2. Runtime of the unit shall be scheduled by the FMS.
3. When unit is scheduled to run, the compressor, heat/cool reversing valve and supply fan shall energize in heating or cooling mode as required to satisfy the thermostat setpoint.

4. When the compressor is unable to meet the heating requirements, the auxiliary strip heat shall energize.
5. When the room humidity rises above the dehumidification setpoint, the compressor shall energize in cooling mode. If the space temperature falls below setpoint while in dehumidification mode, the reheat reversing valve shall open to the reheat coil. If further heat is required, the auxiliary heater shall energize.
6. When equipped, outdoor air delivery systems shall modulate based on room CO² levels.

1.6 HEATING, VENTILATION AND HUMIDIFICATION SYSTEMS

- A. Electric Unit Heaters: When space temperature falls below thermostat setpoint, the unit fan and heating coils shall energize.
- B. Fans: See fan schedule.
 1. Where fans are indicated to be interlocked with room lighting, furnish starters/contactors as required for control operation.
 2. Exhaust Fan: Where exhaust fan serves more than a single space; provide a line voltage relay for each room and connect relays in parallel so that turning lights on in any room will start exhaust fan.
 3. Exhaust fans controlled by the FMS shall run continuously when the building is occupied. When unoccupied, these fans shall turn off.

1.7 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract.
- B. Shop Drawings showing operating sequences of various equipment, devices, components, and materials included in the Text and defining the components' contribution to the system.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232300 - REFRIGERANT PIPING AND CONDENSATE DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants. It also includes piping used for air conditioning condensate drainage.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data for each valve type and refrigerant piping specialty specified.
- C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
 - 1. Refrigerant piping indicated is schematic only. Size and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.
- D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.
- E. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with provisions of the following codes:
 - 1. ASME B31.5, "Refrigeration Piping."
 - 2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."
- D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Refrigerants:
 - a. Allied Signal Inc.; Genetron Refrigerants.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Elf Atochem North America, Inc.
 - d. ICI Americas Inc.; Fluorochemicals Bus.
 - 2. Refrigerant Valves and Specialties:
 - a. Danfoss Electronics, Inc.
 - b. Eaton Corporation; Industrial Control Div.
 - c. Emerson Electric Company; Alco Controls Div.
 - d. Henry Valve Company.
 - e. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
 - f. Sporlan Valve Company.

2.2 PIPES AND TUBES

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Copper Tube: ASTM B 88, Type L.

2.3 PIPE AND TUBE FITTINGS

- A. Copper Fittings: ASME B16.22, wrought-copper streamlined pattern.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

2.5 VALVES

- A. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.
- B. Pressure-Regulating Valves: Conform to ARI 770; pilot operated, forged brass or cast bronze with pilot operator, stainless-steel bottom spring, pressure-gage tappings, 24-V dc standard coil, and wrought-copper fittings for solder-end connections.
- C. Pressure-Regulating Valves: Conform to ARI 770; direct acting, brass with pilot operator, stainless-steel diaphragm, standard coil, and solder-end connections.
- D. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.
- E. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- F. Hot-Gas Bypass Valve: Adjustable, sized for capacity equal to last step of compressor unloading; solder-end connections.

2.6 REFRIGERANT PIPING SPECIALTIES

- A. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.
- B. Permanent Filter-Dryer: 500-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

2.7 RECEIVERS

- A. 6-Inch Diameter and Smaller: ARI 495, UL listed, steel, brazed; 400-psig pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. More than 6-Inch Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code, Section 8D; 400 psig with tappings for liquid inlet and outlet valves, pressure relief valve, and liquid-level indicator.

2.8 REFRIGERANT

- A. ASHRAE 34, R-410-A: Pentofluoroethane Difluoromethane.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Aboveground refrigerant piping: Type ACR copper tubing.
- B. Aboveground condensate drain piping: Type L copper tubing.

3.3 INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23.
- C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Insulate refrigerant suction lines and hot gas lines. Insulate all refrigerant lines on inverter-driven split systems and variable refrigerant flow system.
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- G. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- I. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
 - 3. Install traps and double risers where indicated or where required to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.

- J. Use fittings for changes in direction and branch connections.
- K. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- L. Reduce pipe sizes using eccentric reducer fittings installed with level side down.
- M. Install refrigerant valves according to manufacturer's written instructions.
- N. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.
- O. Electrical wiring for solenoid valves is provided under Division 23 and specified in Division 26 Sections. Coordinate electrical requirements and connections.
- P. Mount thermostatic expansion valves in any position, close to evaporator.
 - 1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
 - 2. Install valve so diaphragm case is warmer than bulb.
 - 3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 - 4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- Q. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.
- R. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.
- S. Charge system per industry accepted standards for systems utilizing R-410A, or manufacturer's recommended procedures if more stringent than industry standards. The following is an outline of the triple evacuation method.
 - 1. Pull initial vacuum on the line set testing for a leak. If it holds then pressure test with Nitrogen at 300 psi minimum.
 - 2. Pump system down, recharge with Nitrogen to 2 psi. Perform this step two times.
 - 3. Pump system down, re-pressurize with Nitrogen and then evacuate system to 500 microns. Hold for 30 minutes.
 - 4. Break vacuum with refrigerant and charge per manufacturer's directions.

3.4 HANGERS AND SUPPORTS

- A. General: Hangers, supports, and anchors are specified in Division 23 Sections. Provide according to ASME B31.5 and MSS SP-69.
- B. Adjustable steel clevis hangers or swivel loop hangers for individual horizontal runs less than 20 feet in length.

- C. Roller hangers and spring hangers for individual horizontal runs 100 feet or longer.
- D. Pipe rollers for multiple horizontal runs, 100 feet or longer supported by a trapeze.
- E. Spring hangers to support vertical runs.
- F. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
 - 1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- G. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction is specified in Division 23 Sections.
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.6 VALVE INSTALLATIONS

- A. Install refrigerant valves according to manufacturer's written instructions.
- B. Provide liquid line solenoid valves for 7½-ton systems and larger, and where recommended by the HVAC equipment manufacturer.
 - 1. Install solenoid valves in horizontal lines with coil at top.
 - 2. Electrical wiring for solenoid valves is provided under Division 23 and specified in Division 26 Sections. Coordinate electrical requirements and connections.
- C. Provide thermal expansion valve (TXV) or electronic expansion valve (EEV) on all systems:
 - 1. For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.
 - 2. Size valves to provide full rated capacity of cooling coil serviced. Coordinate selection with evaporator coil and condensing unit.
 - 3. Install valves in accordance with equipment and valve manufacturer's instructions.
- D. Install pressure-regulating and relief valves as required by ASHRAE 15.

3.7 SPECIALTIES APPLICATION AND INSTALLATION

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install pressure relief valves on ASME receivers, and pipe to outdoors.
- C. Install filter-dryers in liquid line adjacent to receivers, coils and before each solenoid valve.
- D. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.

3.8 CONNECTIONS

- A. Electrical: Conform to applicable requirements of Division 26 Sections for electrical connections.

3.9 FIELD QUALITY CONTROL

- A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.
 - 1. Pressure test with nitrogen per accepted industry practices using soap bubbles or electronic leak detector. Test to no leakage.
- B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- C. Repair leaks using new materials; retest.

3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements. Adjust hot gas bypass valve for proper unloading.

3.11 CLEANING

- A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.12 COMMISSIONING

- A. Charge system per industry accepted standards for systems utilizing R-410A, or manufacturer's recommended procedures if more stringent than industry standards. The following is an outline of the triple evacuation method.
 - 1. Pull initial vacuum on the line set testing for a leak. If it holds then pressure test with Nitrogen at 300 psi minimum.
 - 2. Pump system down, recharge with Nitrogen to 2 psi. Perform this step two times.

3. Pump system down, re-pressurize with Nitrogen and then evacuate system to 500 microns. Hold for 30 minutes.
4. Break vacuum with refrigerant and charge per manufacturer's directions.

END OF SECTION 232300

SECTION 233113 - METAL DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 23 Section "Duct Accessories" for flexible duct materials, dampers, duct-mounted access panels and doors, turning vanes, duct silencers, fabric ducts, pre-insulated outdoor ductwork, and turning vanes.
 - 2. Division 23 Section "HVAC Insulation" for external duct and plenum insulation.
 - 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 4. Division 23 Section "Diffusers, Registers, Grilles and Louvers."
 - 5. Division 23 Section "Air Terminals," for constant-volume control boxes, variable-air-volume control boxes, and reheat boxes.
 - 6. Division 23 Section "Control Systems Equipment" for automatic volume control dampers and operators.
 - 7. Division 23 Section "Testing, Adjusting, and Balancing."

1.2 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 4 inches to plus 10 inches water gage.

1.3 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Duct Liner.
 - 2. Sealing Materials.
- C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
 - 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire-rated and other partitions.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- D. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.
- E. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices
- F. Maintenance data for volume control devices, fire dampers, and smoke dampers.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
 - 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
 - 2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
- C. Carbon Steel Sheets: ASTM A 366, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

- A. General: Comply with NFPA Standard 90A.

- B. Materials: ASTM C 1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.
1. Thickness: 1 inch.
 2. Density: 1-1/2 pounds.
 3. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 deg F.
 4. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.
 5. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C 916.
 6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
 - a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
 - b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

2.3 SEALING MATERIALS

- A. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for class 1 ducts.
- B. Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.
- C. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, zinc plated steel, threaded rod.
1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1995 Edition, for sheet steel width and gage and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
2. For stainless steel ducts, provide stainless steel support materials.
3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
3. Square throat, round heel elbows shall not be used.

2.6 SPECIAL DUCT FABRICATION

A. Fabricate laboratory hood exhaust ducts with 16 gage, stainless steel sheets. Weld seams and joints. Conform to NFPA Standard 45.

2.7 STATIC PRESSURE CLASSIFICATION

A. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

1. Low Pressure Supply Ducts: 1 inch water gage.
2. Return Ducts: 1 inch water gage, negative pressure.
3. Low Pressure Exhaust Ducts: 1 inch water gage, negative pressure.

B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

2.8 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1995 Edition, Figures 2-1 through 2-10.

2.9 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
 - 1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.
- I. Perforated Inner Liner: Construct inner liners with perforated 28 gauge sheet metal. Provide 3/32-inch diameter perforations with an overall open area of 23 percent.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Install ducts with the fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.
- M. Low pressure supply duct takeoffs shall be equivalent to Crown 306 or equal by Flexmaster or United McGill. Medium pressure takeoffs shall be conical type.
- N. Low pressure round duct runouts to supply diffusers may be "snap-lock" duct meeting the pressure classification.
- O. Exposed round duct shall be medium pressure spiral duct with mill-phosphatized treatment. Prime and paint - color selected by the Design Professional.

3.2 LABORATORY HOOD EXHAUST DUCT INSTALLATIONS

- A. Install without dips or traps that may collect residues.
- B. Weld all seams and joints airtight.

3.3 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints as follows:

1. Conditioned Spaces:

- a. Supply duct pressure classification 2-inches water gage and greater and exhaust ducts: All transverse joints and longitudinal seams.
- b. Supply duct pressure classification less than 2-inches water gage and all return duct: All transverse joints and longitudinal seams.
- c. Return and Exhaust Duct: All transverse joints and longitudinal seams.

2. Unconditioned Spaces:

- a. Supply duct pressure classification 2-inches water gage and greater: All transverse joints, longitudinal seams, and duct wall penetrations.
- b. Supply duct pressure classification less than 2-inches water gage and all return duct: All transverse joints, and longitudinal seams.
- c. Return and Exhaust Duct: All transverse joints.

3. Outdoor Spaces:

- a. All supply and return duct: All transverse joints, longitudinal seams, and duct wall penetrations.
- b. Exhaust Duct: All transverse joints.

B. Solvent based sealant shall only be used in applications where freezing may occur before sealant is cured. Water-based sealant shall be used in all other applications.

C. Seal externally insulated ducts prior to insulation installation.

D. All duct sealing shall be in accordance with ASHRAE standard 90.1.

3.4 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Chapter 5.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install concrete insert prior to placing concrete.

F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.5 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Duct Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.
- D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.
- E. Low pressure round supply duct takeoffs shall be equivalent to Crown 306 adjustable 45 degree takeoff. Other acceptable manufacturers include, but are not limited to, Flexmaster and United McGill.

3.6 FIELD QUALITY CONTROL

- A. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
- B. All ductwork shall be approved by the Design Professional prior to the application of external insulation. In the absence of such approval, smoke testing, pressure testing or other leakage testing of ductwork shall be required.
- C. Conduct duct pressure tests in the presence of the Design Professional after the testing has demonstrated that the duct system meets the stated leakage criteria.
- D. Determine leakage from entire medium pressure system or section of the system by relating leakage to the total system airflow capacity.
- E. The following systems shall be pressure tested in accordance with SMACNA's HVAC Air Duct Leakage Test Manual, and meet the stated criteria:
 - 1. Medium pressure supply ductwork: test at 4.5 inches water column static pressure, with a maximum allowable leakage rate of 0.5%.
 - 2. Medium pressure exhaust ductwork: test at 2.0 inches water column static pressure, with a maximum leakage of 1%.
 - 3. Low pressure return and exhaust ductwork: test at 1.0 inches water column static pressure, with a maximum leakage of 1%.
 - 4. Low pressure return and exhaust ductwork: test at 1.0 inches water column static pressure, with a maximum leakage of 1%.
- F. Do not pressurize systems above the maximum design operating pressure (static pressure classification.) Give 7 days' advanced notice for testing.

- G. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage. Integrity of ductwork shall be approved by the Design Professional prior to application of insulation.

3.7 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Manual volume control dampers.
 - 2. Fire and smoke dampers.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors and panels.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
 - 7. Pre-insulated outdoor ductwork.
 - 8. Accessories hardware.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract.
- B. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Manual volume control dampers.
 - 2. Fire and smoke dampers.
 - 3. Duct-mounted access panels and doors.
 - 4. Flexible ducts.
- C. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:
 - 1. Special fittings and volume control damper installation (both manual and automatic) details.
 - 2. Fire and smoke damper installations, including sleeves and duct-mounted access door and panel installations.
- D. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.
- E. Maintenance data for volume control devices, fire dampers, and smoke dampers.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUAL VOLUME CONTROL DAMPERS

- A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft.
- B. Standard Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications.
- C. Steel Frames: Hat-shaped, galvanized-steel channels, minimum of 16 gage, and with mitered and welded corners. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.
 1. Roll-Formed Steel Blades: 16-gage galvanized steel.
 2. Blade Axles: Galvanized steel.
 3. Tie Bars and Brackets: Galvanized steel.
- D. Low-Leakage Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside of air stream, and suitable for horizontal or vertical applications. Dampers shall have a maximum leakage of 10 cfm per square foot of 4-inch static pressure.
- E. Jackshaft: 1-inch-diameter, galvanized-steel pipe or 1/2" square galvanized bar stock rotating within a pipe bearing assembly mounted on supports at each mullion and at each end of multiple damper assemblies. Provide appropriate length and number of mounting to connect linkage of each damper of a multiple damper assembly. Cut groove in the end of the shaft parallel with damper blades.
- F. Damper Control Hardware: Zinc-plated, die-cast core with a heavy-gage dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Provide center hole to suit damper operating rod size. Provide elevated platform for insulated duct mounting.

2.2 FIRE DAMPERS

- A. General: UL-labeled according to UL Standard 555, "Standard for Fire Dampers. Ratings shall be dynamic system operation at 350° temperature. Dampers shall be rated for 2000 fpm velocity and 4" wg pressure.
- B. Fire Rating: 1-1/2 or 3 hours, as indicated by wall ratings on Architectural Plans.
 - 1. Frame: Type B (blades outside airstream); fabricated with roll-formed, 21-gage, galvanized-steel; with mitered and interlocking corners. Furnish multi-blade dampers where required by code.
 - 2. Mounting Sleeve: Factory-installed or field-installed galvanized steel.
 - a. Minimum Thickness: 0.056-inch (16-gage) or 0.138-inch (10-gage) thick as indicated, and length to suit application.
 - b. Exception: Furnish narrow frame damper without sleeve in applications where damper is mounted in rated partition behind supply/return register.
 - 3. Mounting Orientation: Vertical or horizontal as indicated.
 - 4. Blades: Roll-formed, interlocking, 21-gage galvanized steel. In place of interlocking blades, provide full-length, 21-gage, galvanized-steel blade connectors.
 - 5. Fusible Link: Replaceable, 165 deg F rated.

2.3 CEILING FIRE DAMPERS

- A. General: UL listed and labeled; comply with the construction details for the tested floor/roof-ceiling assemblies as indicated in the UL Fire Resistance Directory.
- B. Frame: 20-gage, rectangular or round, galvanized steel; style to suit ceiling construction.
- C. Blades: 22-gage galvanized steel with non-asbestos refractory insulation.
- D. Volume Control Adjustment: Provide UL-labeled, fusible volume control adjustment.
- E. Fusible Link: Replaceable, 165 deg F rated.

2.4 SMOKE AND FIRE/SMOKE DAMPERS

- A. General: UL-labeled according to UL Standard 555S, "Standard for Leakage Rated Dampers for Use in Smoke Control Systems." Combination fire and smoke dampers shall also be UL-labeled for 1-1/2 hour rating according to UL Standard 555 "Standard for Fire Dampers with a Class II leakage rating." Dampers shall be tested at a 350°F air temperature. Dampers shall be rated for 2000 fpm velocity and 4" wg pressure.
- B. Fusible Link: Replaceable, 165 deg F rated as indicated (fire/smoke dampers only.)
- C. Frame and Blades: 16-gage galvanized steel.

- D. Mounting Sleeve: Factory-installed, 18-gage galvanized steel, length to suit wall or floor application.
- E. Electric actuator with end switch. All actuators shall be factory mounted outside of the airstream. Furnish damper end switch for control interlocks

2.5 TURNING VANES

- A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.
- B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.
- C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fiber glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Provide construction and airtightness suitable for duct pressure class.
- B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of locks as indicated for duct pressure class. Provide vision panel where indicated. Provide cam latches.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.
- E. Insulation: 1-inch-thick fiber glass or polystyrene foam board.

2.7 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL Standard 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 3rd Edition, Figure 7-8.
- C. Extra-Wide Metal-Edged Connectors: Factory-fabricated with a strip of fabric 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.

- D. Transverse Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 4-3/8-inch-wide, 24-gage, galvanized sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.
- E. Conventional, Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloroprene.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
- F. Conventional, Outdoor System Flexible Connectors Fabric: Glass fabric double coated with Du Pont's HYPALON or other synthetic-rubber weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz./sq. yd. and tensile strength of 285 lbf/inch in the warp, and 185 lbf/inch in the filling.
- G. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd.
 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.

2.8 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts - Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.
- C. Flexible Ducts - Uninsulated: Corrugated aluminum.
- D. Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch-thick, glass fiber insulation around a continuous inner liner.
1. Reinforcement: Steel-wire helix encapsulated in the inner liner.
 2. Outer Jacket: Glass-reinforced, silver mylar.
 3. Inner Liner: Polyethylene film.
 4. Pressure Rating: 10-inches wg, positive.
 5. R value: 6.0

2.9 ACCESSORIES HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments and provide in length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action. Provide in sizes from 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.
- B. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to the manufacturer's UL-approved printed instructions.
- E. Install fusible links in fire dampers.
- F. Label access doors according to Division 23 Sections.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.

- C. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233423 - POWER AND GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. Ceiling-mounted ventilators.
4. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 1. Certified fan performance curves with system operating conditions indicated.
 2. Certified fan sound power ratings.
 3. Motor ratings and electrical characteristics plus motor and electrical accessories.
 4. Material gages and finishes, including color charts.
 5. Dampers, including housings, linkages, and operators.

- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
- D. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- E. Maintenance data for power ventilators to include in the operation and maintenance manual.

1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- E. UL Standard: Provide power ventilators that comply with UL 705.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.
- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

1.8 EXTRA MATERIALS

- A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Acme
2. Barry Blower
3. Berner
4. Broan Mfg. Co., Inc.
5. Carnes Co.
6. Central Blower Co.
7. Cincinnati Fan & Ventilator Co.
8. Cook (Loren) Co.
9. Essick Air Products, Breidert.
10. Greenheck Fan Corp.
11. Hartzell
12. ILG Industries, Inc.
13. Jenn Industries Inc.
14. Lau Division Philips Industries, Inc.
15. Mars
16. Penn
17. Twin City

2.2 UTILITY SET FANS

- A. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and accessories.
- B. Housings: Fabricated of steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
1. Housings Discharge Arrangement: Adjustable to 8 standard positions.
- C. Fan Wheels: Single width, single inlet, welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
1. Blade Materials: Steel.
 2. Blade Type: Die formed, backward inclined or forward curved, as scheduled.
- D. Fan Shaft: Turned, ground, and polished steel keyed to wheel hub.
- E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with AFBMA 9, L-50 of 200,000 hours.
- F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor: 1.5.

2. Motor Pulleys: Adjustable pitch for use with motors through 5 horsepower (HP); fixed pitch for use with motors larger than 5 HP. Select pulley so pitch adjustment is at the middle of the adjustment range at fan design conditions.
3. Belts: Oil resistant, non-sparking, and non-static; matched sets for multiple belt drives.
4. Belt Guards: Fabricate of steel for motors mounted on the outside of the fan cabinet.

G. Accessories: The following accessories are required as indicated:

1. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades and felt edges in steel frame installed on fan discharge.
2. Access Doors: Gasketed doors with latch-type handles.
3. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
4. Spark-Resistant Construction: AMCA 99 construction, as indicated.
5. Inlet Screens: Removable wire mesh.
6. Drain Connections: 3/4-inch threaded coupling drain connection installed at lowest point of housing.
7. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
8. Disconnect.

2.3 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
1. Up-blast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- C. Housing: Removable, galvanized steel, mushroom-domed top; square, one-piece, hinged, aluminum base with venturi inlet cone.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 4. Fan and motor isolated from exhaust air stream.
- F. Accessories: The following items are required as indicated:
1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 3. Bird Screens: Removable 1/2-inch mesh, aluminum or brass wire.

4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Roof Curbs: Galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
 - a. Configuration: Self-flashing without a cant strip, with mounting flange.
 - b. Configuration: Built-in cant and mounting flange.
 - c. Configuration: Built-in raised cant and mounting flange.
 - d. Overall Height: 12 inches above roof surface.

2.4 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.
- B. Housing: Galvanized steel.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille (Ceiling Mounted): Aluminum grille with baked enamel finish. Furnish in-line configuration where indicated.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in. (Integral disconnect device.)
- F. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
- G. Accessories: Manufacturer's standard roof jack or wall cap, and transition fittings where indicated on the drawings.

2.5 PROPELLER FANS

- A. Description: Belt-driven or direct-drive propeller fans, as indicated, consisting of fan blades, hub, housing, orifice ring, motor, drive, and accessories.
- B. Housings: Galvanized steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat after assembly.
- C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.
- D. Cast-Aluminum Fan Wheels: Replaceable, cast-aluminum blades fastened to cast-aluminum hub. Factory set pitch angle of blades.
- E. Extruded-Aluminum Fan Wheels: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub. Factory set pitch angle of blades.

- F. Belt-Driven Drive Assembly: Resiliently mounted to the housing, statically and dynamically balanced and selected for continuous operation at the maximum rated fan speed and motor horsepower (HP), with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor: 1.4.
 2. Fan Shaft: Turned, ground, and polished steel keyed to wheel hub.
 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - a. Ball-Bearing Rated Life: AFBMA 9, L-10 of 100,000 hours.
 4. Pulleys: Cast iron with split, tapered bushing, dynamically balanced at factory.
 5. Motor Pulleys: Adjustable pitch for use with motors through 5 HP; fixed pitch for use with motors larger than 5 HP. Select pulley so pitch adjustment is at the middle of the adjustment range at fan design conditions.
 6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 7. Belt Guards: Fabricate of steel for motors mounted on the outside of the fan cabinet.
- G. Accessories: The following accessories are required as indicated:
1. Gravity Shutters: Aluminum blades in aluminum frame, interlocked blades with nylon bearings.
 2. Motor-Side Back Guard: Galvanized steel, conforming to OSHA specifications, removable for maintenance.
 3. Wall Sleeve: Galvanized steel to match fan and accessory size.
 4. Weathershield Hood: Galvanized steel to match fan and accessory size.
 5. Weathershield Front Guard: Galvanized steel with expanded metal screen.
 6. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 7. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.6 MOTORS

- A. Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B. Furnish premium efficiency motors for all above 1 horsepower.
- C. Enclosure Type: The following features are required as indicated:
1. Open drip-proof motors where satisfactorily housed or remotely located during operation.
 2. Guarded drip-proof motors where exposed to contact by employees or building occupants.

2.7 ROOF MOUNTED GRAVITY VENTILATORS

- A. Ventilator shall be stationary unit of type indicated on the drawings, all aluminum construction with curb base and aluminum bird-screen. Ventilator shall be provided with matching prefabricated roof curb same as specified for roof exhaust fans. Secure ventilator to roof curb with cadmium-plated steel screws, minimum of two on each side.

2.8 FACTORY FINISHES

- A. Sheet Metal Parts: Prime coat before final assembly.
- B. Exterior Surfaces: Baked-enamel finish coat after assembly.
- C. Aluminum Parts: No finish required.

2.9 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required as indicated:
 - 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
 - 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install power ventilators according to manufacturer's written instructions.
- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 23 Sections.
 - 1. Support utility set fans on concrete housekeeping bases or roof supports using neoprene pads. Secure units to anchor bolts installed in housekeeping base.
 - 2. Support utility set fans on concrete housekeeping bases or roof supports using housed spring isolators. Secure units to anchor bolts installed in housekeeping base.

3. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. Furnish a minimum of one screw per side of the curb.
 4. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
 5. Ceiling Units: Suspend units from structure using steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23.

3.3 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 26 Sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.6 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 COMMISSIONING

A. Final Checks before Startup: Perform the following operations and checks before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
7. Disable automatic temperature-control operators.

B. Starting procedures for fans are as follows:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Measure and record motor voltage and amperage.

C. Shut unit down and reconnect automatic temperature-control operators.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

E. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals.

C. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.

D. Demonstrate operation of power ventilators.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS, GRILLES AND LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, grilles and louvers.

1.3 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.
- D. Louver: Exterior wall air device which resists the penetration of rain.

1.4 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, grilles and louvers indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
 - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, grilles and louvers and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered.
- B. NFPA Compliance: Install diffusers, registers, grilles and louvers according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Acceptable manufacturers shall be:

- 1. Anemostat Products
- 2. Arrow
- 3. Carnes Co.
- 4. Greenheck
- 5. Hart and Cooley
- 6. Tuttle and Bailey
- 7. Krueger
- 8. J&J
- 9. Nailor
- 10. Titus
- 11. Metal*Aire
- 12. Vent Products
- 13. Price
- 14. Dowco
- 15. Ruskin

- B. All louver face ceiling diffusers shall have four cones and removable cores.

- C. All exterior louvers shall be 6-inches deep.

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, grilles and louvers are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, grilles and louvers level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Design Professional for a determination of final location.
- C. Install diffusers, registers, grilles and louvers with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, grilles and louvers to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, grilles and louvers, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

SECTION 234000 – BIPOLAR IONIZATION AIR PURIFICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This section describes the design, performance and installation of a bipolar ionization air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.3 REFERENCED CODES & STANDARDS

- A. The following codes and standards are referenced throughout. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867

1.4 QUALITY ASSURANCE

- A. The bipolar ionization air purification system shall be a product of an established manufacturer in the USA.
- B. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- C. Technologies that do not address gas disassociation such as UV lights, powered particulate filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.
- D. Projects designed using ASHRAE Standard 62.1 *IAQ Procedure* shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 or later version to validate acceptable indoor air quality at the quantity of outside air scheduled.
- E. The bipolar ionization system shall have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007.

- F. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.001 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the output of the bipolar ionization unit shall be no more than 0.0012 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.
- G. Electrical Component Standard: Provide components that comply with NFPA 70 "National Electrical Code."
- H. NEMA Compliance: Provide electrical components required as part of filter assembly that are listed and labeled by UL and comply with applicable NEMA standards.
- I. Listing and Labeling: Provide electrical components that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- J. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B pertaining.

1.5 SUBMITTALS

- A. Submit manufacturer's technical product data for ion generators including:
 - 1. Schedule of bipolar ionization units indicating model number and quantity of each type required for each application.
 - 2. Submittal sheet for each type of bipolar ionization unit and accessories furnished; indicating construction, dimensions, electrical data, and mounting details.
 - 3. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 or later version to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with reduced outside air).
 - 4. Product drawings detailing all physical, electrical and control requirements.
- B. Operating & Maintenance Data: Submit O&M data and recommended spare parts list.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of products shall be in factory fabricated shipping cartons. Identify on outside of carton the type of product contained within. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.7 WARRANTY

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Aerisa
2. Air Oasis
3. Bioclimatic
4. Global Plasma Solutions (GPS)
5. Plasma Air

2.2 GENERAL

A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit scheduled.

B. All other suppliers of comparable products requesting prior approval shall:

1. Submit a request for prior approval at least 15 days prior to bid date. Requests received after that time will not be considered.
2. In addition, as part of the prior approval request, Bipolar Ionization manufacturers must submit their IAQ calculations that prove conformance to ASHRAE Standard 62.1-2007 or later version with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.
3. Submit independent test data from ETL or UL on the ozone chamber test.
4. Submit at least two other end user references in the same application with contact phone number, email, equipment used and application at that facility. Manufacturers not having the above references in similar applications using the same equipment models as proposed on the current project shall not be acceptable.

2.3 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA

A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a plasma ion generator with bipolar ionization output as described here within.

B. The bipolar ionization system shall be capable of:

1. Effectively killing microorganisms downstream of the bipolar ionization equipment (e.g., mold, bacteria, virus).
2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
3. Reducing space static charges.
4. Reducing space particle counts.

- C. The bipolar ionization system shall operate in such a manner that equal amounts of positive and negative ions are produced. Uni-polar (or single pole) ion devices shall not be acceptable.
1. Airflow rates may vary through the full operating range of a VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
 2. Velocity Profile: The air purification device shall not have a maximum velocity profile.
- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions to the air purification system.
- E. Ionization Equipment Requirements:
1. Electrode Specifications (bipolar ionization):
 - a. Each plasma generator with bipolar ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Bipolar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time and corrosion.
 - b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating.
 - c. Ionization output from each electrode shall be a minimum of 5 million ions/cc when tested at 2" from the ion generator.
 - d. Manufacturer shall demonstrate that no voltage potential exists due to exposed electrical components in the duct system or plenum.
 2. Fan-mounted units
 - a. Bipolar ionization units for fan-mounted applications shall be brush type needlepoint units designed to be mounted at the fan inlet.
 - b. Each bipolar ionization unit shall be rated up to 2,400 CFM or 6 tons nominal capacity. For airflows greater than 2,400 CFM, multiple units shall be utilized.
 - c. The bipolar unit housing is made of acrylonitrile butadiene styrene, contains an LED ionization output-indicator, and an in-line 1 Amp fuse
 - d. The unit shall contain two (2) mounting feet such that when mounted, the needlepoint brushes are oriented perpendicular to the flow of air entering the fan wheel.
 - e. Provide self-cleaning accessories to periodically clean electrodes.
 3. Duct mounted units
 - a. Where so indicated on the plans and/or schedules, bipolar ionization units equal to Aerisa 8000 series shall be supplied and installed by the mechanical contractor. The contractor shall follow all manufacturer IOM instructions during installation.
 - b. Bipolar ionization units shall be furnished with a factory-equipped gasketed mounting flange to prevent air leakage. Gasketed flange shall be a minimum of 1 1/8" wide around the perimeter of the ionizer to insure no leakage occurs.

- c. Bipolar ionization units shall be field installed in a location that is convenient for visual inspection, removal, and servicing. They shall include an ion indicator light clearly visible from below the installed location.
 - d. Bipolar ionization units shall include internal short circuit protection, overload protection, and automatic fault reset. Manual fuse replacement shall not be accepted.
 - e. Bipolar ionization units shall include an external BMS interface to indicate ion generator status and alarm.
4. Certifications
- a. Bipolar ionization units shall be tested and listed by either UL or ETL according to UL Standard 867 – Electrostatic Air Cleaners.
 - b. The operation of the electrodes or bipolar ionization units shall conform to UL 867 with respect to ozone generation.

F. Electrical Requirements:

- 1. Ion generators shall contain a built-in power supply and directly accept 24V AC and shall connect to the fan and common terminals of the fan coil unit or air handling unit served. Ion generators requiring a loose 24V, 120V or 230V transformer or power supply will not be accepted.
- 2. Wiring, conduit and junction boxes shall be furnished and installed by the electrical contractor within housing plenums and shall be UL and NEC NFPA 70 approved.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.2 ASSEMBLY & INSTALLATION: PLASMA GENERATOR WITH BI-POLAR IONIZATION

- A. All equipment shall be assembled and installed with a high level of workmanship to the satisfaction of the owner, Design Professional and engineer.
- B. Any material damaged by handling, water or moisture shall be replaced by the mechanical contractor at no cost to the owner.
- C. All equipment shall be protected from damage on a daily basis throughout construction.
- D. Install electrical devices in accordance with manufacturer's instructions and with electrical divisions of the specifications.

3.3 COMMISSIONING & TRAINING

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.
- B. Provide to the owner a portable hand-held ion counter with a calibrated range of 0 to 20,000 ions/cm³ and an accuracy of +/- 25% within the specified range. Ion counter shall have automatic zeroing capability on 10-minute intervals.

END OF SECTION 234000

SECTION 237432 - PACKAGED DEDICATED OUTSIDE AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes dehumidification units used for swimming pool room dehumidification and packaged makeup air units.
- B. Related Sections include the following:
 - 1. Division 23 Section "Mechanical Vibration Controls and Seismic Restraints" for manufactured isolation bases.
 - 2. Division 23 Section "Control Systems Equipment" for temperature-control devices, and control wiring and control devices connected to packaged makeup air units.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
- D. Maintenance Data: For equipment to include in the operations and maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

- B. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

- 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

- C. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.6 COORDINATION

- A. Coordinate installation of pads and equipment supports

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 - 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Material Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fan Belts: One set for each belt-drive fan.
 - 2. Filters: Three (3) sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Dedicated Outside Air Units:
 - a. AAON
 - b. Greenheck
 - c. Trane Co. (The)
 - d. Valent
 - e. Mitsubishi
 - f. United Cool Air

2.2 PACKAGED DEDICATED OUTSIDE AIR UNITS

A. Unit Description:

1. Unit shall be a packaged rooftop unit specifically designed for 100% outdoor applications. Unit shall be completely factory-assembled, tested, internally wired, fully charged and shipped in one piece. Unit(s) shall consist of insulated weather-tight casing with outdoor intake hood, compressors, air-cooled condenser coils, condenser fans, evaporator coils, supply fan, motors and drives, unit controls, condenser reheat coil, gas-fired heat and filters.
2. Unit shall be single piece construction as manufactured at the factory. Packaged units shall be constructed for installation on a roof curb.
3. Unit shall be factory run tested to include the operation of all fans, compressors, heat exchangers, safeties, limits and control sequences.

B. Unit Casing:

1. Cabinet: Outer casing shall be 18-gauge minimum A60 galvaneal steel painted with baked industrial enamel finish. Internal casing shall be 24 gauge minimum G90 galvanized steel except for motor supports, which shall be 14 gauge minimum G90 galvanized steel. Panels shall be insulated with 2" thick fiberglass insulation or 2" spray foam insulation.
2. Access panels/doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge minimum painted galvanealed steel.
3. Control Panel: the unit control panel section shall be laid out to provide separation high and low voltage components per UL requirements. The control panels shall also be fully gasketed, hinged and provided with quick release latch and door for easy access.

C. Electrical:

1. Provide a factory-installed non-fused disconnect switch which satisfies NEC requirements for a service disconnect switch. Disconnect handle shall be accessible through the control box door such that high voltage power must be off before door can be opened.
2. Provide a factory installed 115V convenience outlet capable of ground fault protection.

- D. Air Filters: Filters shall mount integral within unit casing and be accessible through hinged access panels. Filters shall be 2-inch thick pleated media throwaway filter, 30% rated efficiency.
- E. Fans - Supply: Supply fan blower assembly shall consist of an electric motor and direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails mounted on 1.125" thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.
- F. Evaporator Coil Section:
1. Provide two individual evaporator coils with heavy duty aluminum fins mechanically bonded to copper tubes and mounted to a single coil and support. Evaporator coils shall be independently circuited to optimize cooling and drying capacity at full and part load conditions. Coils shall also utilize internally enhanced tubing for maximum efficiency.
 2. Provide a thermostatic expansion valve (TXV) for each refrigerant circuit. Factory pressure and leak test call at 390 psig.
 3. Provide drain pan pitched in two planes that is fully drainable. Drain pan shall be double-wall foamed in place assembly constructed of stainless steel. Evaporator coils to be mounted above drain pan to allow the drain pan to be fully inspected and cleaned.
- G. Condenser Reheat Coil Section:
1. Provide reheat coil for recovered hot refrigerant gas with heavy duty aluminum fins mechanically bonded to copper tubes. Factory pressurize and leak test to 390 psig.
 2. Provide integral subcooling circuit to prevent premature refrigerant flashing and to ensure maximum operating efficiency.
 3. Reheat coil system to provide modulating reheat capacity between the reheat coil and matching outdoor condenser coil as required per the supply air temperature setpoint via the unit micro-processor.
 4. Reheat coil to be factory installed in unit with adequate spacing away from upstream evaporator coils to prevent entrained moisture from reentering the reheated supply air.
- H. Condenser Section:
1. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Factory pressurize and leak test to 390 psig.
 2. Provide sub-cooling circuit(s) integral with condenser coils to maximize operating efficiency and prevent premature refrigerant flashing.
 3. Provide vertical discharge, direct drive fans with steel blades and three phase motors. Fans shall be statistically and dynamically balanced. Motors shall be permanently lubricated with built in current and thermal overload protection and have weather tight slingers over motor bearings.
 4. Provide factory-installed louvered seel coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components. Louvered panels shall be fabricated from minimum 20 gauge galvanized steel and be rigid enough to provide permanent protection for shipping and pre/post-installation.
- I. Refrigeration system:
1. Compressor: Hermetic digital scroll compressor with isolated mounting and electric crankcase heater.

2. Provide thermostatic temperature motor winding control for protection against excessive temperature caused by over/under-voltage operation or loss of charge. Provide high and low pressure cutouts.
 3. Provide integral coil frost protection based on refrigerant circuit suction temperature.
- J. Outdoor Air Section:
1. Provide 100% outdoor air via a fully integrated factory installed 100% modulating outdoor air damper for economizer mode. Damper operation shall be through micro-processor based controls and shall remain open at 100% when the building is occupied for required ventilation.
 2. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.
 3. Outdoor air inlet hood to be factory installed with bird screen.
- K. Dampers:
1. Provide low leakage dampers.
 2. Outside air damper shall be parallel blades. A modulating damper actuator shall be factory installed and controlled via the unit microprocessor.
 3. Return air damper shall be parallel blades. A modulating damper actuator shall be factory installed and controlled via the unit microprocessor for unoccupied re-circulation.
- L. Microprocessor Controls: The unit shall be controlled by a factory-installed microprocessor programmable controller capable of controlling the unit as a stand-alone system and capable of interface with the owner's facility management system through a factory provided BACNet interface. The unit controller shall incorporate an integral LCD screen providing text readouts of status and have a built in keypad to permit access of read-out screens without the use of ancillary equipment, devices or software

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide all labor, refrigerant, and material required for a complete installation. Work to be performed shall be in accord with local codes, regulations, and OSHA standards.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Provide a suitable space for the equipment with proper access and entries. Store in a clean, dry place and protect from the outdoor environment. Handle with care to avoid damage.

3.3 INSTALLATION

- A. Install unit per plans and manufacturer's installation recommendations.

3.4 FIELD QUALITY CONTROL

- A. Clean, check and perform all preliminary start-up procedures before final operation of the unit, per manufacturer's recommendations.
- B. Provide complete operation/maintenance manuals (in English) and include the following minimum lists: parts list, electrical and control drawings, and refrigeration piping drawings. Manufacturer's representative shall instruct owners/operators of the unit regarding its functions and sequence of operation.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
 - 2. Review data in the maintenance manuals.
 - 3. Schedule training with Owner, through the Design Professional, with at least 7 day's advance notice.

END OF SECTION 237432

SECTION 238126 - SPLIT SYSTEM HEAT PUMPS AND AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes split system heat pump units and related components.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
 - 2. Refrigerant piping schematics showing sizes and accessories.
- C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists.
- D. Maintenance Data: For equipment to include in the maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

- D. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

- 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

- E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver indoor and outdoor units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.6 COORDINATION

- A. Coordinate installation of concrete pads and equipment supports

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 - 1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Material Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Filters: Three sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ductless Split Systems:

- a. Carrier Corp.
- b. Daikin
- c. LG
- d. Mitsubishi
- e. Samsung
- f. Sanyo
- g. Trane

2.2 DUCTLESS SPLIT SYSTEMS

- A. Provide a split system heat pump and air conditioning units utilizing outdoor condenser and indoor evaporator connected by copper refrigerant tubing with flare type fittings. Outdoor unit shall contain sufficient R-410a to charge complete system. The condenser shall be equipped with an inverter-driven compressor and external brass service valves and charging port. Indoor unit shall be equipped with electric resistance back-up heater (where indicated.) The outdoor condenser shall have a capillary tube metering device located internally. Evaporator and condenser coils shall be constructed with aluminum fins mechanically bonded to copper tubes. The system shall bear the ARI Certification symbol.
- B. Indoor unit shall be mounted as indicated on the Drawings. Controls shall be integral type IC thermostat with settings for multiple speeds and automatic position, 12 hour timer with ON/OFF settings, night set-back and energy saver position. Furnish hard-wired remote control panel. Cooling and heating capacities and electrical characteristics shall be as shown on the Drawings. Supplemental electric resistance heat shall be provided where indicated.
- C. Provide disconnect device for indoor unit when power is supplied by outdoor unit. Furnish low ambient controls and condenser coil guards unless indicated otherwise.
- D. Furnish sea-coast protection on outdoor unit.

2.3 REFRIGERANT PIPE SIZE

- A. Pipe sizes shown on the drawings are for estimating purposes only. Final pipe sizes shall be selected by the manufacturer and shall be included in the submittal data. Accessories (larger crankcase heaters, liquid line solenoid valve, oversize suction accumulators, wind baffles, etc.) required or recommended by the equipment manufacturer shall be provided at no additional cost.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine installation locations for compliance with requirements for conditions affecting installation and performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Furnish float switch for unit shutdown interlock.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping to allow service and maintenance.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. Furnish flexible connections at all unit connections.
- C. Electrical: Conform to applicable requirements in Division 26 Sections.
- D. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

- A. Verify that installation is as indicated and specified.
- B. Complete manufacturer's installation and startup checks and perform the following:
 - 1. Level unit on support structure.
 - 2. Inspect for visible damage to unit casing.
 - 3. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
 - 4. Verify that clearances have been provided for servicing.
 - 5. Check that labels are clearly visible.
 - 6. Verify that controls are connected and operable.
 - 7. Remove shipping bolts, blocks, and tie-down straps.
 - 8. Verify that filters are installed.

9. Adjust vibration isolators.
 10. Check acoustic insulation.
- C. Lubricate bearings on fan.
- D. Check fan-wheel rotation for correct direction without vibration and binding.
- E. Adjust fan belts to proper alignment and tension.
- F. Start unit according to manufacturer's written instructions.
1. Perform starting of refrigeration in summer only.
 2. Complete startup sheets and attach copy with Contractor's startup report.
- G. Check and record performance of interlocks and protection devices; verify sequences.
- H. Operate unit for an initial period as recommended or required by manufacturer.
- I. Calibrate thermostats.
- J. Check internal isolators.
- K. Check controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.
- L. Simulate maximum cooling demand and check the following:
1. Compressor refrigerant suction and hot-gas pressures.
 2. Short circuiting air through condenser or from condenser to outside-air intake.
- M. After starting and performance testing, change filters, vacuum heat exchanger and cooling and condenser coils, lubricate bearings and adjust belt tension.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 2. Review data in the maintenance manuals.
 3. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.
 4. Provide letter from factory service representative stating that equipment is installed and operating as per manufacturer's recommendations.

END OF SECTION 238126

SECTION 238127 - VARIABLE REFRIGERANT FLOW HEAT PUMP SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes variable refrigerant flow (VRF) heat pump systems and related components. Systems are capable of providing simultaneous heating and cooling in adjacent zones on a single VRF system (heat recovery type.)
- B. Related Sections include the following:
 - 1. Division 23 Section "Mechanical Vibration Controls and Seismic Restraints" for manufactured isolation bases.
 - 2. Division 23 Section "Control Systems Equipment" for temperature-control devices, and control wiring.

1.3 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
 - 2. Refrigerant piping schematics showing sizes and accessories.
 - 3. Manufacturer's certified engineering design conforming to the contract documents.
- C. Commissioning Reports: Indicate results of startup and testing commissioning requirements. Submit copies of checklists including printed data logs indicating pressure and vacuum tests performed on each system. Commissioning shall be performed and/or supervised by a factory authorized agent and not the installing contractor.
- D. Maintenance Data: For equipment to include in the maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Fabricate, label and install refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration;" ASHRAE 34, "Domestic and Safety Classification of Refrigerants;" and, applicable building codes.
- B. Energy Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Performance shall be certified by AHRI in accordance with Standard 1230: Variable Refrigerant Flow Multi-Split Air Conditioners and Heat Pumps.
- E. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. The units shall be listed by electrical laboratories (ETL) and bear ETL label.
- F. Comply with NFPA 70.
- G. Project specific engineered system design shall be performed by an agent authorized by the manufacturer.
- H. Refer to specification section "General HVAC Provisions" for installing contractor qualifications. Installing contractor shall be certified by the equipment manufacturer/supplier.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver indoor and outdoor units as factory-assembled units with protective crating and covering.
- B. Coordinate delivery of units in sufficient time to allow movement into building.
- C. Handle units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.6 COORDINATION

- A. Coordinate installation of equipment supports

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

- B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
 - 1. Warranty Period, Compressors and Units: Manufacturers standard, but not less than 7 years after date of Material Completion. (5-years for all parts.)
- C. System shall be installed by Manufacturer's factory certified and trained dealer.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Filters: Two sets of washable filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. VRF Split Systems:
 - a. Carrier
 - b. Daikin
 - c. Mitsubishi
 - d. Samsung
 - e. LG
 - f. York
 - 2. Two-pipe or three-pipe systems are acceptable.

2.2 OUTDOOR UNIT

- A. General: Outdoor unit shall be designed and configured for use specifically with other VRF components included in the system. The outdoor units shall be equipped with multiple circuit boards that interface to the central VRF controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.
 - 1. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.

2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 63 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
 3. All refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
 4. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
 5. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
 6. The outdoor unit shall have a high-pressure safety switch, over-current protection, crankcase heater and DC bus protection.
 7. The outdoor unit shall have the ability to operate with a maximum height difference and have total refrigerant tubing length indicated on the drawings.
 8. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
 9. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
 10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- B. Unit Cabinet: The casing(s) shall be fabricated of galvanized steel, bonderized and finished.
1. Units cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models.
- C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
 2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
 3. All fan motors shall be mounted for quiet operation.
 4. All fans shall be provided with a raised guard to prevent contact with moving parts.
 5. The outdoor unit shall have vertical discharge airflow unless indicated otherwise on the drawings.
- D. Refrigerant: R410A refrigerant shall be required for outdoor unit systems.
- E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
 2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
 3. The coil shall be protected with an integral metal guard.
 4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors are not acceptable.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-8% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz and shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.3 BRANCH CIRCUIT (BC) CONTROLLERS (OR HEAT RECOVERY UNITS)

- A. General: The BC (Branch Circuit) Controllers shall be designed for use with the other VRF system components. These units shall be equipped with a circuit board that interfaces to the VRF controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 120% of rated capacity.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant: R410A refrigerant shall be required.

D. Refrigerant valves:

1. The unit shall be configured to support branching arrangements and capacities indicated on the drawings.
2. Each branch shall have multiple two-position valves to control refrigerant flow.
3. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without interruption to overall system operation. Each service valve shall have an access port on the indoor units side of the valve. Service valve assemblies shall be completely insulated to prevent condensation.

4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- E. Integral Drain Pan: An integral insulated condensate pan and drain shall be provided.
- F. Electrical:
 1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz and shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
 2. The BC Controller shall be controlled by integral microprocessors.
 3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 WALL-MOUNTED INDOOR UNIT

- A. General: Wall-mounted indoor unit section and shall have a modulating linear expansion device.
- B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
 1. The casing shall have a white finish.
 2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
 3. There shall be a separate back plate which secures the unit firmly to the wall.
- D. Fan:
 1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
 4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter: Return air shall be filtered by means of an easily removable, washable filter.
- F. Coil:
 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 2. The tubing shall have inner grooves for high efficiency heat exchange.
 3. All tube joints shall be brazed with phos-copper or silver alloy.
 4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the indoor units shall be insulated.

G. Controls: This unit shall use controls provided by manufacturer to perform functions necessary to operate the system. Refer to Part 3 of this specification for details on controllers and other control options.

2.5 STANDARD 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE (INDOOR UNIT):

A. General: The unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
3. Cabinet shall have an outlet to serve branch supply ductwork.
4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
9. If specified, the grille shall have an optional i-see sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.

D. Filter: Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the indoor units shall be insulated.

F. Controls: This unit shall use controls provided by manufacturer to perform functions necessary to operate the system.

2.6 COMPACT 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE (INDOOR UNIT):

A. General: The unit shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be a compact 22-7/16" wide x 22-7/16" deep so it will fit within a standard 24" square suspended ceiling grid.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake
3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.
4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter: Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.

6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4" inches above the condensate pan.
 7. Both refrigerant lines to the indoor units shall be insulated.
- F. Controls: This unit shall use controls provided by manufacturer to perform functions necessary to operate the system.

2.7 2-WAY CEILING-RECESSED CASSETTE WITH GRILLE (INDOOR UNIT):

- A. General: The unit shall be a two-way cassette indoor unit that recesses into the ceiling with a ceiling grille and shall have a modulating linear expansion device.
- B. Indoor Unit. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
1. The cabinet shall be space-saving ceiling recessed.
 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 3. The two-way grille shall be fixed to bottom of cabinet allowing for two-way airflow.
- D. Fan:
1. The indoor fan shall be an assembly with one line-flow fan direct driven by a single motor.
 2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. The indoor fan shall consist of four (4) speeds, Low, Mid1, Mid2, and High.
- E. Filter: Return air shall be filtered by means of a long-life washable permanent filter.
- F. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 2. The tubing shall have inner grooves for high efficiency heat exchange.
 3. All tube joints shall be brazed with phos-copper or silver alloy.
 4. The coils shall be pressure tested at the factory.
 5. A condensate pan and drain shall be provided under the coil.
 6. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 23 inches above the condensate pan.
 7. Both refrigerant lines to the indoor units shall be insulated.
- G. Controls: This unit shall use controls provided by manufacturer to perform functions necessary to operate the system. Please refer to Part 3 of this guide specification for details on controllers and other control options.

2.8 CEILING-CONCEALED DUCTED INDOOR UNIT

- A. General: The unit shall be a ceiling-concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and shall have a modulating linear expansion device.
- B. Indoor Unit. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet:
 - 1. The unit shall be, ceiling-concealed, ducted.
 - 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
- D. Fan:
 - 1. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor.
 - 2. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - 3. The indoor unit shall have a ducted air outlet system and ducted return air system.
- E. Filter:
 - 1. Return air shall be filtered by means of a standard factory installed return air filter.
 - 2. Optional return filter box (rear or bottom placement) with high-efficiency filter shall be available for all ceiling-concealed ducted indoor units.
- F. Coil:
 - 1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 - 2. The tubing shall have inner grooves for high efficiency heat exchange.
 - 3. All tube joints shall be brazed with phos-copper or silver alloy.
 - 4. The coils shall be pressure tested at the factory.
 - 5. A condensate pan and drain shall be provided under the coil.
 - 6. The condensate shall be gravity drained from the fan coil.
 - 7. Both refrigerant lines to the indoor units shall be insulated.
- G. Controls: This unit shall use controls provided by manufacturer to perform functions necessary to operate the system. Please refer to Part 3 of this guide specification for details on controllers and other control options.

PART 3 – CONTROLS

3.1 OVERVIEW

- A. General: The VRF system controls network shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

3.2 ELECTRICAL CHARACTERISTICS

- A. General: The control network shall operate at 24 VDC. Controller power and communications shall be via a common non-polar communications bus.
- B. Wiring type:
 - 1. Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the system manufacturer.
 - 2. Network wiring shall be CAT-5e with RJ-45 connection.

3.3 VRF SYSTEM CONTROLS NETWORK

- A. The VRF system controls network consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The controls network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.

3.4 REMOTE CONTROLLERS

- A. Remote Controller:
 - 1. Thermostat Interface: Each indoor heat pump shall have a thermostat interface device that allows a networked thermostat as specified in section 230900 to operate the heat pump unit.
 - 2. The remote controller shall be capable of controlling up to 16 indoor units (defined as 1 group). The remote controller shall be approximately 5" x 5" in size and white in color with a light-green LCD display. The remote controller shall support a selection from multiple languages (Spanish, German, Japanese, Chinese, English, Russian, Italian, or French) for display information. The remote controller supports temperature display selection of Fahrenheit or Celsius. The remote controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto, dry, and fan), temperature set point, fan speed setting, and airflow direction setting. The remote controller shall support timer settings of on/off/temperature up to 8 times in a day in 1-minute increments. The remote controller shall support an Auto Off timer. The remote controller shall be able to limit the set temperature range from the controller. The room temperature shall be sensed at either the remote controller or the indoor unit dependent on the indoor unit dipswitch setting (default shall be to sense at the remote wall-mounted controller). The remote controller shall display a four-digit error code in the event of system abnormality/error.
 - 3. The remote controller shall require no addressing. The remote controller shall connect using two-wire, stranded, non-polar control wire to the connection terminal on the indoor unit.

- B. Centralized Controller: The centralized controller shall be capable of controlling via a PC a maximum of 50 indoor units across multiple outdoor units. A field supplied PC shall be required for the centralized controller. The centralized controller shall be approximately 5"x11" in size and shall be powered from a Power Supply Unit. The centralized controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The centralized controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the centralized controller shall include on/off, operation mode selection (cool, heat, auto, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. Since the centralized controller provides centralized control it shall be able to enable or disable operation of local remote controllers via the PC. In terms of scheduling, the centralized controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.
1. Standard software functions shall allow the building manager to securely log into each centralized controller via the PC's web browser to support operation monitoring, scheduling, error email, and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions shall be provided for personal browser for PCs and MACs and for Tenant Billing. BACnet® interface shall be available through software operating on a dedicated PC.

3.5 WEB-BASED USER INTERFACE

- A. Licenses per function, per centralized controller shall be required. All PCs shall be field supplied.
1. PC-Monitoring: The control network shall be capable of monitoring and operating all indoor units from a networked PC's web browser for up to 50 units per centralized controller.
 2. PC Scheduling: The control network shall be capable of creating customized daily, weekly, and annual schedules from a network PC's web browser for up to 50 units per centralized controller. Schedules shall be applied to a single indoor unit, a group of indoor units, or collectively (batch) to all indoor units controlled by the centralized controller.
 3. Online Error Email: The controls network shall be capable of sending detailed alerts to customizable distribution lists based on user defined error types.
 4. Personal Web Browser: The controls network shall be capable of allowing up to 50 individual users to monitor and control user defined zones via a network PC or MAC's web browser.
 5. Online Maintenance Diagnostics : The controls network shall be capable of performing maintenance diagnostics via a network PC and centralized controller using furnished software.

3.6 SERVICE TOOL

- A. All software and connection hardware necessary to connect to Owner's computers directly to the VRF system network and perform diagnostics and maintenance shall be furnished to the Owner prior to maintenance training.

3.7 POWER SUPPLY

- A. The power supply shall supply 24VDC for the centralized controller and for the central control transmission.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Examine installation locations for compliance with requirements for conditions affecting installation and performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.2 INSTALLATION

- A. Install units according to manufacturer's written instructions.
- B. Install units level and plumb, maintaining manufacturer's recommended clearances.
- C. Equipment and appliances containing evaporators or cooling coils shall be installed with a means of condensate removal in compliance with IMC 307.2. A water level detection device conforming to UL 508 shall be provided for all main condensate pans and be interlocked to de-energize the unit's main fan should the drain pan water level exceed the main drain pipe connection level. Additional measures shall be taken where indicated on drawings or specifications.

4.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Install piping to allow service and maintenance.
 - 2. All flare fittings shall be appropriate for the refrigerant application. Flare nuts shall be tightened to the torque specifications indicated by the manufacturer.
- B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. Furnish flexible connections at all unit connections.
- C. Network Integration: Coordinate with the Owner's IT department to facilitate integration of the VRF system controllers into the Owner's data network.
- D. Electrical: Conform to applicable requirements in specification Sections.

E. Ground equipment.

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

4.4 COMMISSIONING

- A. Verify that installation is as indicated and specified. Furnish manufacturer's system commissioning report with warranty number.
- B. Complete manufacturer's installation and startup checks and perform the following:
 1. Level unit on support structure.
 2. Inspect for visible damage to unit casing.
 3. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
 4. Verify that clearances have been provided for servicing.
 5. Check that labels are clearly visible.
 6. Verify that controls are connected and operable.
 7. Remove shipping bolts, blocks, and tie-down straps.
 8. Verify that filters are installed.
 9. Adjust vibration isolators.
 10. Check acoustic insulation.
- C. Lubricate bearings on fan.
- D. Check fan-wheel rotation for correct direction without vibration and binding.
- E. Adjust fan belts to proper alignment and tension.
- F. Start unit according to manufacturer's written instructions.
 1. Perform starting of refrigeration in summer only.
 2. Complete startup sheets and attach copy with Contractor's startup report.
- G. Check and record performance of interlocks and protection devices; verify sequences.
- H. Operate unit for an initial period as recommended or required by manufacturer.
- I. Calibrate thermostats.
- J. Check internal isolators.
- K. Check controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.
- L. Simulate maximum cooling demand and check the following:
 1. Compressor refrigerant suction and hot-gas pressures.
 2. Short circuiting air through condenser or from condenser to outside-air intake.

- M. After starting and performance testing, change filters, vacuum heat exchanger and cooling and condenser coils, lubricate bearings and adjust belt tension.

4.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 2. Review data in the maintenance manuals.
 - 3. Schedule training with Owner, through the Design Professional, with at least 7 days' advance notice.
 - 4. Provide letter from factory service representative stating that equipment is installed and operating as per manufacturer's recommendations.

END OF SECTION 238127

SECTION 238239 - UNIT HEATERS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

- A. This Section includes unit heaters and cabinet unit heaters.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract.
- B. Product data for each type of product specified.
- C. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.
- D. Samples of cabinet finish colors for approval.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Design Professionals and owners, and other information specified.
- F. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of unit heaters.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm experienced in manufacturing unit heaters similar to those indicated for this Project and that have a record of successful in-service performance.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

1.5 EXTRA MATERIALS

- A. Furnish the following extra materials, matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.
- B. Cabinet Unit Heater Filters: Furnish three spare filters for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide unit heaters by one of the following:
 - 1. Brasch Manufacturing Co., Inc.
 - 2. Carrier Corp.
 - 3. Lennox Industries Inc.
 - 4. Markel Products Company.
 - 5. Marley Electric Heating Company; Berko Division.
 - 6. Sterling Radiator Division/Mestek, Inc.
 - 7. Trane Co.
 - 8. Marley Electric Heating Company; Q-Mark Division.
 - 9. Indeeco
 - 10. Raywall

2.2 ELECTRICAL UNIT HEATERS

- A. Heating Elements: Nickel-chromium heating wire element; free from expansion noise and 60-Hz hum; embedded in magnesium oxide, insulating refractory; and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends are enclosed in terminal box. Fin surface temperature does not exceed 550 deg F at any point during normal operation.
- B. Heater Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.
- C. Fan and Motor: Direct-drive propeller fan and manufacturer's standard motor. Motors sized 1 hp and less include motor overload protection.
- D. Wiring Terminations: Match conductor materials and sizes indicated.
- E. Discharge Configuration: Horizontal discharge with horizontal, adjustable louvers.
- F. Discharge Configuration: Vertical discharge with radial louver diffuser.
- G. Optional Accessories: Include the following:
 - 1. Wall thermostat.

2. Safety-switch disconnect on cover of terminal box.
3. Magnetic contactors.
4. Fan-delay relay.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and supports to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit heaters as indicated, according to manufacturer's written instructions and NFPA 90A.
- B. Connect unit heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

3.3 FIELD QUALITY CONTROL

- A. Testing: After installing unit heaters and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units and retest.

3.4 CLEANING

- A. Replace filters in each cabinet unit heater.

END OF SECTION 238239

SECTION 25 50 30 - SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the modification, design, documentation, assembly, test, installation, field testing, startup, training, and final documentation for the Supervisory Control and Data Acquisition System (SCADA).

1. Work includes, but is not necessarily limited to, the following:
 - a. All PLC hardware, programmable logic controller I/O Boards and other appurtenances as indicated and specified herein and as required by the pump stations descriptions.
 - b. All engineering, hardware and software development, installation, startup, calibration services, programming and necessary supervision required.
 - c. New operator workstations complete with accessories as described herein.
 - d. Testing and operational demonstrations as specified.
 - e. Training programs as specified.
 - f. Preparation of instruction manuals.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
1. Section 25 50 00 – Controls and System Integration
 2. Division 26
 3. Division 40
 4. Division 41
 5. Division 44
 6. Division 4

1.3 SUBMITTALS

- A. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the ENGINEER, for their review, submittal documents in accordance with Section 01 33 00. Submittals shall include full details, shop drawings, catalog cuts and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these specifications. Specifically, the CONTRACTOR shall submit the following materials:

1. Block diagram and operational description of the system showing all major components and their interconnections and interrelationships. Label each diagram and specify all external power and communications interfaces. All diagrams shall be in an 11 by 17 format. Required documentation sets shall be furnished in bound hardcopy and final documentation shall also be provided in electronic format on CD.
2. Drawings of equipment to be supplied shall include, as a minimum: overall dimension details for each panel, console, etc., including internal and external arrangements and door

- mounted operator devices with nameplate designations. Wiring diagrams of equipment including field device connections shall be included and specific installation/wiring requirements identified.
3. Operational Description shall include the principal functions/capabilities of the personal computer (PC) and PLC's as provided and configured /programmed. Included shall be a description of system communications.
 4. Provide a detailed Bill of Materials along with descriptive literature identifying component name, manufacturer, model number, and quantity supplied.
 5. Provide Warranty information for entire installation.
- B. Software Submittals:
1. Provide complete user manuals for all supplier configured software and firmware. For ancillary software such as operating systems, spreadsheets, etc. being supplied under this contract, only a listing of the manuals, which will be included with the Operations and Maintenance documentation is required.
 2. Sample communication and control database programs for project in hardcopy form. As a minimum, hardcopy form shall be fully documented, including code, comments, addressing data and cross-references, etc. Every line or section of code shall be accompanied by a comment describing its function.
 3. Provide initial graphic display and report format layouts as described later in this specification. List and briefly describe all operator interface functions provided at the PC, including: alarm annunciation and acknowledgment, status displays, control capabilities, report generation, event logging, charting and trending, etc.
- C. Operation and Maintenance Manuals
1. The CONTRACTOR shall provide hard-covered; ring bound loose-leaf O&M manuals in accordance with Section 01782. In addition to "as-built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section.
 2. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument.
 3. Operation and Maintenance manuals shall include copies of all commented PLC programs written to accomplish the monitoring and control functions specified, as well as all passwords associated with the SCADA system. Programs shall be updated after startup is complete, with the program(s) provided to the OWNER on compact disk (CD). Two (2) copies to be provided.
 4. The contents of the O&M manuals shall be generally organized as follows:
 - a. System Hardware/Installation
 - b. System Software, including all passwords
 - c. Operation
 - d. Maintenance and Troubleshooting
- D. Test Outlines and Procedures Submittals: Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with this specification.
- E. Spares and Expendable Recommendations: The CONTRACTOR shall provide a list of recommended spares and expendable items. The list shall be exclusive of any spares furnished under this Contract.

1.4 QUALITY ASSURANCE

- A. The CONTRACTOR'S attention is directed to the fact that all specified instruments and controls must form a completely integrated system and, as such, the system integrator shall become familiar with requirements necessary to provide equipment specified for the system regardless of manufacture, and shall be responsible to the CONTRACTOR for the complete and satisfactory operation of the entire plant instrumentation and control system.
1. These specifications cover the intended function of the equipment, but do not necessarily cover all details necessary for a complete, operable and functional system. The manufacturer shall supply all devices and appurtenances necessary to provide a complete, operable and satisfactory system as indicated or specified.
- B. The naming of a manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a standard of excellence for the material used, and to indicate a principle of operation desired. Alternate equipment shall be submitted to the ENGINEER at least 14 days prior to bid (in accordance with the following prebid submittal requirements and Section 01625). The ENGINEER will issue an addendum prior to bid listing approved alternate control systems.
- C. Control System Integrator
1. It is the intent of these specifications and drawings that the Contractor shall engage an approved and qualified Control System Integrator to provide the system as specified and indicated.
 2. The Control System Integrator shall have a minimum of five years experience in providing similar operational systems of which a listing may be requested.
 3. The System Integrator shall have an UL508A panel shop and have a Field Service Engineer within 4 hours of the site. The Contractor shall submit with the proposed System Integrator's proposal a detailed explanation of how the System Integrator will meet the requirements noted above. This written explanation shall include locations of personnel, panel shops, driving distances/response times to a call for service, as well as number of personnel available to service the plant in the prescribed area (broken down between technicians and field service engineers for clarity).
 4. The Control System Integrator shall design and furnish a complete, integrated and functionally operating system, warranted to perform the intended functions as herein specified.
 5. Provide or supply all hardware and software specified herein or required and provide all required and specified collateral services in connection with the system such as testing, calibration, start-up, operation and maintenance manuals, and operator training without additional cost to the OWNER.
 6. Provide system integration for control systems by other equipment manufacturers supplying control equipment.
- D. Individual Responsibilities
1. System Integrators
 - a. The system integrator shall have the authority to organize the data layout within each individual device used in the user interface system. This said data layout will be based on the device provider's listing of available data points for monitor and control. The system integrator will dictate the data used and the layout needed to facilitate the most efficient system possible. This efficient system methodology will be to minimize the

number of queries needed to retrieve the necessary information. The system integrator may also require the separation of status and control registers to more easily facilitate expansion and/or changes to the data structure. The system integrator does not have the authority to change the program algorithm for the subsystem device. The actual functionality of the system is under direct control of the ENGINEER and the pertinent specifications. The system integrator is responsible for contacting each device provider and attaining the listing of data available and then communicating with the provider the proper organization of data in the system.

2. Device Providers

- a. Device providers must generate a listing of all pertinent data available for monitor and control within the user interface system. Based on this listing, the system integrator shall direct the provider on how the data shall be made public and also how to efficiently organize data as needed by the user interface. Device must be capable of communicating this data over the deemed standard protocol for this job such as Modbus TCP or Ethernet-IP over Ethernet TCP/IP. The device provider is responsible for making the said device to respond properly and safely to changes made in control variables. It is the device provider's responsibility to be in contact with the system integrator to ensure proper operation within the integrators scope of work. The device provider has direct control over the program algorithm for the portion of the system the said device is specified.

E. System Integrator/Supplier(s)

1. Electric Machine Controls (EMC), Birmingham, Al

1.5 RESPONSIBILITY FOR COMPLETE SYSTEM

- A. The CONTRACTOR shall be responsible for and shall provide for the design, supply, delivery, installation, certification, calibration and adjustment, software configuration, testing and startup, OWNER training, warranty and routine future field services, of a complete coordinated system which shall perform the specified functions.
- B. The OWNER and the ENGINEER will review system technical information as submitted by the CONTRACTOR for software; operating system, database, control strategies and the graphical user interface, i.e. report and log formats, graphics, trends, alarming, etc. for complete compliance with these specifications.

1.6 WARRANTY

- A. Systems supplier shall furnish a hardware and software maintenance contract for the computer system, providing for an 8-hour response time in normal working hours, five days per week for the length of the warranty period.
 1. For any service visit during this period, provide the OWNER and ENGINEER with a written report stating the reason for equipment failure and recommendations to prevent recurrence.
- B. At the end of this period, the maintenance contract shall be made available for transfer to the OWNER.

PART 2 PRODUCTS

2.1 GENERAL

- A. Major components of this system shall include the specified software, materials, equipment, and installation required to implement a complete and operational SCADA system along with any associated panel or field modifications.
- B. In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, to the greatest extent possible, like items of equipment provided hereunder shall be the end products of one (1) manufacturer.
- C. Requirements for the electrical work associated with the installation of the SCADA system and associated instrumentation equipment are as specified in Division 26 – ELECTRICAL.
- D. The functions and features specified herewith are the minimum acceptable requirements for the SCADA system. The provided system shall equal or exceed each requirement.
- E. In some cases, the specifications may allow the accomplishing of certain functions by means of more than one hardware/firmware/software approach. No other approach may be taken that is different from that specified.
- F. The total control and monitoring system shall consist of a series of individual control and monitoring sub-systems, each configured to perform a specific function associated with the total system operational scheme.
- G. All equipment and materials shall be new, unused and proved by previous use of similar products to be completely suitable for the service intended.
- H. All of the equipment shall be the manufacturer's latest and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the SCADA system. The completed system shall be compatible with the functions required and other equipment furnished by the CONTRACTOR.
- I. System manufacturer to supply "as-built" drawings containing all necessary information for proper maintenance and operation of the system.
 - 1. Wire log table showing connections (wire terminations) between all furnished components to be supplied to facilitate field wiring.
 - 2. Interconnection information between system components and equipment found in other sections of these Specifications shall be complete with all necessary interconnection information.
 - 3. Notes, which refer to equipment manufacturer's drawings for proper interconnection will not be acceptable.

2.2 PLANT SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

A. System Description and System Components:

- 1. The new overall Supervisory Control and Data Acquisition (SCADA) System shall be installed as described herein:
 - a. New PLC's and SCADA Equipment at the Wastewater Treatment Plant for the new process areas and new equipment.
 - b. Existing PLC's as noted on the drawings are to be upgraded.
 - c. The remainder of the existing plant that is to remain online shall remain connected to the system as is currently done. If changing of this connection is required, contact the Engineer for approval.
 - d. Main Computers and Graphics to be at the following location(s):
 - 1) Existing Computing Systems and VTScaDa software for SCADA system will be utilized. The graphics, controls, and monitoring setup for the existing plant

shall be migrated over to the new HMI system, keeping the existing plant that is to remain working as it is currently.

2. Internet Modem equipment for remote access into the new SCADA system shall be provided by the owner and is currently existing. The Systems Integrator shall coordinate with the owner to ensure this equipment works with their design for compatibility. The Systems Integrator shall supply and install a new firewall capable of handling at a minimum of 100IPSec connections, coordinating with the owner's IT staff to ensure compatibility.

2.3 PLC COMMUNICATION DATA HIGHWAY

- A. Communications between the computer system running the HMI software and the various programmable logic controllers (PLCs) and computers located around the system shall utilize an Ethernet IP Cat-6 data highway, fiber optic cable, or wireless communications. All Ethernet IP Cat-6 or fiber optic cable terminations shall be the responsibility of the certified cable provider.

2.4 SOFTWARE ALARMS

- A. All analog inputs to the SCADA system shall have the capability for low and high software alarms. Where low and/or high software alarms are not specified elsewhere in this document, they shall initially be turned off or set for 0% (low alarm) and 100% (high alarm) of the signal range. This will help eliminate nuisance alarms during checkout and start-up. All software alarms shall be reviewed with the Owner, or his designee, during panel start-up. The System Integrator shall change all software alarm set-point values as instructed by the plant superintendent. For critical alarms, the System Integrator shall configure the associated graphic symbol to flash or change color when in an alarm condition. Critical software alarms that provide equipment interlock, (i.e., pump low level stop) will be generated in the (PLC) but set-points will be set at the HMI.

2.5 CONTROL STRATEGY

- A. General
 1. The Instrumentation and Controls System Integrator shall coordinate actual control strategy requirements and implementation with site constraints, equipment vendors, contractors and operations personnel.
 2. Coordinate with process drawings and specifications for a complete control scenario. Also, the systems integrator is required to have process control meetings with the owner, operators, and engineers prior to starting work so that the SCADA system functions as desired.

PART 3 EXECUTION

3.1 GENERAL

- A. Coordinate all work with the ENGINEER and OWNER to avoid conflicts, errors, delays and unnecessary interference with operation of the process during installation, testing, cutover and startup.

3.2 SURFACE CONDITIONS

- A. Systems Integrator shall visit site prior to bid to examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.3 INSTALLATION OF SYSTEM

- A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
- B. Install the work of this Section in strict accordance with the original design and the manufacturer's recommended installation procedures as approved by the ENGINEER, anchoring all components firmly into position for long life under hard use.

3.4 SOFTWARE REDEVELOPMENT

- A. Human-Machine Interface (HMI) software shall be fully configured by the instrumentation and control system vendor to integrate the new data. Reports, graphics displays, real-time trends, historical trends, security, and alarming shall be developed by the instrumentation and control system vendor through a collaborative effort between the ENGINEER, OWNER, and control system vendor. Graphics displays shall be designed by the instrumentation and control system vendor.

3.5 SYSTEM DISPLAY AND REPORTS

A. Graphic Display Design Meeting and Submittal

1. Two (2) one-day graphic display design meeting shall be held with the Engineer and Owner's personnel to discuss specific details of overall design of the graphic displays including discussions of the particular signals which are to be displayed on each graphic display and also specific control strategies for the redeveloped system. The meeting shall be held at the Owner's facility. There shall be an initial development meeting, followed by a comment and review period. Once that has been accomplished, a second meeting shall be held to review changes and make any final comments before implementation.
2. Prior to the meeting the instrumentation and control system vendor shall submit detailed sketches of the proposed new graphics displays and a detailed narrative for each of the proposed control strategies to the Engineer for review.
3. Travel and living costs to/from the Owner's facility shall be borne by each party.

B. Control Strategy Design Meeting

1. Two (2) one-day process control strategy design meeting shall be held with the Engineer and Owner's personnel to discuss specific details of overall control of the plant processes including discussions of the specific control strategies for the redeveloped systems. The meeting shall be held at the Owner's facility. There shall be an initial development meeting, followed by a comment and review period. Once that has been accomplished, a second meeting shall be held to review changes and make any final comments before implementation.
2. Prior to the meeting the instrumentation and control system vendor shall submit a detailed narrative for each of the proposed control strategies to the Engineer for review.
3. Travel and living costs to/from the Owner's facility shall be borne by each party.

C. Report Design Meeting

1. A one-day report strategy design meeting shall be held with the Engineer and Owner's personnel to discuss specific details of the various historical data reports and state reports which are to be developed for the system. The meeting shall be held at the Owner's facility.
2. Prior to the meeting the instrumentation and control system vendor shall submit detailed sketches of the proposed new graphics displays and a detailed narrative for each of the proposed control strategies to the Engineer for review.

3. Travel and living costs to/from the Owner's facility shall be borne by each party.

3.6 TRAINING

- A. System supplier to provide operation and maintenance training for Owner's personnel to ensure their adequate knowledge of use of the system.
- B. Training to be conducted on-site by instructors thoroughly familiar with operation of the system.
- C. Analog and digital hardware maintenance training:
 - a. Instruct Owner's maintenance personnel in the proper preventative maintenance and repair tasks associated with system maintenance.
 - b. For analog instrumentation, include detailed instruction of calibration and checking along with familiarization training for basic repair and maintenance tasks that are expected to be encountered.
 - c. For computer hardware maintenance, include general familiarization with computer hardware and peripheral devices with instruction in preventative maintenance tasks associated primarily with peripheral devices. It is not intended that this course will produce trained computer maintenance technicians.
 - d. Include detailed instruction in maintenance and repair work associated with the computer process I/O sub-system.
 - e. Minimum training time for this material to be sixteen (16) hours.
2. Operator familiarization training:
 - a. Instruct Owner's operating personnel in the proper use of the analog and digital process control system.
 - b. Include instruction in the system control steps and basic interface with the computer system.
 - c. Provide sufficient training to Owner's operating personnel so they can respond to the normal tasks required for operation of the plant.
 - d. Minimum training time for this material to be Eight (8) hours.
3. Supervisor and application software training:
 - a. Provide supervisory personnel with a working knowledge of all application software supplied.
 - b. Include basic digital and computer concepts, process control concepts, database configuration, report configuration, graphic display configuration, and control strategy development.
 - c. Minimum training time for this material to be Eight (8) hours.
 - d. Provide supervisory service of a factory trained service engineer, specifically trained on the type of equipment herein specified, for a period of not less than 10 (10) 8-hour day during construction to assist the Contractor in the location of mounting brackets, methods of installing conduit and special cable, mounting, piping, and wiring of one of each type of service, and the methods of protecting all of the equipment prior to placing it into service.
 - e. Upon completion of equipment installation, provide services of the above service engineer for a period of not less than three (3) 8-hour day for calibration and start-up of the equipment and instructing the operating personnel.

3.7 STARTUP SERVICES

- A. All elements of the SCADA system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. The CONTRACTOR shall provide all special

testing materials and equipment. The CONTRACTOR shall coordinate and schedule all of his testing and startup work with the OWNER. As a minimum, the testing shall include both a factory test and a field test. Testing requirements are as follows:

1. Factory Tests: The PC with peripherals, PLC's and all other associated hardware shall be tested at the factory, prior to shipment, so as to demonstrate that each component is operational and meets the requirements of these specifications. Test results shall be certified, with written documentation provided to the OWNER and ENGINEER upon test completion. The OWNER or ENGINEER shall be offered an invitation to witness the factory testing.
2. Field Tests:
 - a. All system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly. Witnessed field tests shall be performed on the complete system. Each function shall be demonstrated to the satisfaction of the OWNER and ENGINEER on a paragraph-by-paragraph basis.
 - b. Each test shall be witnessed and signed off by the CONTRACTOR and the ENGINEER upon satisfactory completion. The CONTRACTOR shall notify the OWNER at least one (1) week prior to the commencement date of the field tests.
- B. Upon final completion of all components determine date of start-up jointly with ENGINEER, OWNER and CONTRACTOR.
- C. System supplier to be responsible for placing of SCADA equipment and systems in operation.
- D. System supplier to provide qualified personnel on the job site until successful operation of system is attained.

3.8 DEFINITION OF ACCEPTANCE

- A. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
 1. All O&M documentation has been submitted, reviewed and approved.
 2. The complete SCADA system and instrumentation have successfully completed all testing requirements specified herein and have successfully been started up.
 3. All OWNER'S staff personnel training programs have been completed.
 4. OWNER/ENGINEER sign a document indicating SCADA system has formally been accepted.

END OF SECTION 25 50 30

SECTION 25 50 00 - CONTROLS AND SYSTEM INTEGRATION

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the requirements for the control equipment and system integrations.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related work specified elsewhere includes:
1. Section 25 5030 – SCADA System
 2. Division 26
 3. Division 40
 4. Division 41
 5. Division 44
 6. Division 46

1.3 SUBMITTALS

- A. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the ENGINEER, for their review, submittal documents in accordance with Section 01 33 00. Submittals shall include full details, shop drawings, catalog cuts and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these specifications. Specifically, the CONTRACTOR shall submit the following materials:
1. Block diagram and operational description of the system showing all major components and their interconnections and interrelationships. Label each diagram and specify all external power and communications interfaces. All diagrams shall be in an 11 by 17 format. Required documentation sets shall be furnished in bound hardcopy and final documentation shall also be provided in electronic format on CD.
 2. Drawings of equipment to be supplied shall include, as a minimum: overall dimension details for each panel, console, etc., including internal and external arrangements and door mounted operator devices with name plate designations. Wiring diagrams of equipment including field device connections shall be included and specific installation/wiring requirements identified.
 3. Operational Description shall include the principal functions/capabilities of the PLC's as configured /programmed. Included shall be a description of system communications.
 4. Provide a detailed Bill of Materials along with descriptive literature identifying component name, manufacturer, model number, and quantity supplied.
 5. Training Material
- B. Test Outlines and Procedures Submittals: Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with this specification.
- C. Operations and Maintenance Data: At a minimum, include the following information.
1. Operating and Calibration instructions.
 2. PLC commented code.
 3. Troubleshooting Information.

4. Wiring Diagrams with wire numbers and termination point.

1.4 COORDINATION

- A. All programming and wire termination shall be performed by an approved systems integrator.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR'S attention is directed to the fact that all specified instruments and controls must form a completely integrated system and, as such, the system integrator shall become familiar with requirements necessary to provide equipment specified for the system regardless of manufacture, and shall be responsible to the CONTRACTOR for the complete and satisfactory operation of the entire instrumentation and control system.
1. These specifications cover the intended function of the equipment, but do not necessarily cover all details necessary for a complete, operable and functional system. The manufacturer shall supply all devices and appurtenances necessary to provide a complete, operable and satisfactory system as indicated or specified.
- B. CONTRACTOR shall use one of the approved Systems Integrators. The System Integrator shall be responsible for all final terminations from the new equipment and instruments to the I/O termination points. Electrical Contractor shall pull all wires to this point, label each wire, and provide this list to the System Integrator.
1. The System Integrator shall have an UL508A panel shop and have a Field Service Engineer within 4 hours of the site. The Contractor shall submit with the proposed System Integrator's proposal a detailed explanation of how the System Integrator will meet the requirements noted above. This written explanation shall include locations of personnel, panel shops, driving distances/response times to a call for service, as well as number of personnel available to service the plant in the prescribed area (broken down between technicians and field service engineers for clarity).
- C. Individual Responsibilities
1. System Integrator
- a. The system integrator shall have the authority to organize the data layout within each individual device used in the user interface system. This said data layout will be based on the device provider's listing of available data points for monitor and control. The system integrator will dictate the data used and the layout needed to facilitate the most efficient system possible. This efficient system methodology will be to minimize the number of queries needed to retrieve the necessary information. The system integrator may also require the separation of status and control registers to more easily facilitate expansion and/or changes to the data structure.
- b. The system integrator does not have the authority to change the program algorithm for the subsystem device. The actual functionality of the system is under direct control of the ENGINEER and the pertinent specifications. The system integrator is responsible for contacting each device provider and attaining the listing of data available and then communicating with the provider the proper organization of data in the system.
2. Device Providers
- a. Device providers must generate a listing of all pertinent data available for monitor and control within the user interface system. It is the device provider's responsibility to be in contact with the system integrator to ensure proper operation within the integrators scope of work. The device provider has direct control over the program algorithm for the portion of the system the said device is specified.

- D. Approved System Integrator/Supplier(s):
 - 1. Electric Machine Controls (EMC), Birmingham, Al
- E. All components shall be from the same manufacturer and supplied by a single source, the system integrator.

PART 2 PRODUCTS

2.1 PROGRAMABLE LOGIC CONTROLLER (PLC)

- A. Product Description: The Programmable Logic Controller with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points as shown on the drawings.
- B. Configuration:
 - 1. Single Processor Systems: Include processor, power supply, random access erasable-programmable read only memory input/output modules, communication modules and remote interface modules.
 - 2. Remote Input/output Unit: Include input/output modules, interface modules, communication modules, and power supply for system inputs and outputs.
 - 3. Modules are to be supplied as specified unless system requirements dictate the use of alternative modules.
- C. Ratings:
 - 1. Input/output Capacity capable of supporting up to three local chassis of I/O (30 slots)
 - 2. Scan Rate of 0.9 milliseconds per Kbytes based on 1k ladder logic program consisting of simple ladder logic and communicator servicing
 - 3. Programming Instructions: Trihedral
 - 4. Bit Execution Time (XIC) of 0.37 microsecond
- D. Programming Language: Ladder Logic
- E. Minimum Programming Instruction Set
 - 1. Language Characteristics: Ladder diagram
 - 2. Logic Operations: AND, OR, XOR, NOT
 - 3. Register Operations: Store, recall
 - 4. Math Operations: Addition, subtraction, multiplication, division, square root, matrix operations
 - 5. Process Control: Proportional-Integral-Derivative

2.2 TELEMTRY UNIT

- A. General:
 - 1. The System Integrator shall make use of readily available products with a proven history of reliable service when used in municipal water and wastewater applications. All equipment shall be new and of the latest design unless specified or indicated otherwise.
 - 2. The SCADA PLC controller is an intelligent, modular unit, capable of both data acquisition and local data processing. It shall monitor and control local equipment in a stand-alone mode as well as being an intelligent node in a distributed system.
 - 3. The RTU operates over an ambient temperature range of -40°C to +75°C (-40°F to 201°F) with relative humidity 5 to 95% (non-condensing).

4. All materials, equipment, and devices shall meet the requirements of UL where UL standards are established for those items and the requirements of NFPA-70.
5. All electrical components of the system shall operate on 120 VAC, 60 Hz, single phase power source except as otherwise noted. Any other devices necessary to obtain proper operation of the instrumentation and control system from these energy sources shall be furnished with the system.
6. Instrumentation equipment and enclosures shall be suitable for the environmental conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines and electrical equipment.
7. All work and materials shall comply with the National Electrical Code (N.E.C) and applicable local regulations and ordinances. Where required by applicable codes, panel assemblies, materials and equipment shall be approved, identified, labeled or listed by Underwriters' Laboratories or other testing organization acceptable to the governing authority.
8. The SCADA PLC controller shall use a truly "open architecture" design using "off-the-shelf" components and a non-proprietary communications protocol.
9. The SCADA PLC controller shall be configured and programmed with standard programming languages such as Relay Ladder Logic (RLL), IEC 61131-3 programming standard and/or ANSI C. Programs shall be developed and downloaded either directly to the PLC controller using a standard RS-232/RJ-45 interface cable, or remotely through the cellular communication network or media such as phone lines, fiber optic cables, copper wire dedicated lines, or wireless radios.

2.3 PLC-BASED I/O SUBSYSTEM ENCLOSURES

- A. It is the intent of this specification to modify minimum requirements for a solid-state programmable logic controller designed to provide high reliability for this application.
 1. The PLC-based Telemetry Units are supplied for the sites indicated.
 2. The internal wiring of the controller is to be fixed, with the logic functions it must perform in a given application to be programmed into its memory.
 3. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable programmable controller system.
 4. RTU's are constructed using "off-the-shelf" programmable logic controllers (PLC's) with modems, surge arrestors, relays, power supplies, and enclosures as required for a fully functioning and fully operational system.
 5. All field wiring terminations are made to terminal strips capable of accommodating up to #12 AWG wire. Terminal strips shall be mounted using DIN rails. Terminal strips are manufactured by Phoenix Contact, Allen-Bradley, Square D or equal. Printed labels are used to designate terminal numbers for each terminal.
 6. A limit switch is mounted on the door of the RTU enclosure. The limit switch is wired to a non-relay-isolated input of the RTU to provide a "RTU Door Open" signal.
 7. All analog inputs, shall be protected from surges using three separate levels of surge/transient suppression. The first level of protection shall be via a 1/4 Amp 3AG size fast acting fuse. Secondary and tertiary protection shall be fulfilled using combination gas discharge and metallic oxide varistor (MOV) surge protection with current limiting resistors. Terminals shall be installed to allow each of the four analog inputs and outputs to be configured for 2-wire or 4-wire process transmitters and to produce either 4 to 20 mA or 1 to 5 VDC outputs to the PLC and any future display or

signal conversion devices. Terminals shall be installed adjacent to the analog surge protection to provide 24 VDC for connections of future 2-wire transmitters.

8. All digital inputs, shall be isolated from field wiring through terminal strips and mechanical relays. Minimum contact rating for relays shall be 10 Amps at 250 VAC.
9. All digital outputs, shall be isolated from field wiring through terminal strips and electro-mechanical relays with contact ratings of 10 Amps at 250 VAC minimum.
10. Communications Protocol
 - a. In order to insure future expandability of the system all communications shall be via Ethernet/IP. No other protocol shall be acceptable.

B. PLC Hardware

1. The Programmable Logic Controller and Components will be supplied by the systems integrator in the locations indicated on the plans, to the meet the following specifications:
 - a. PLC CompactLogix Panels (As shown on the Network Diagram)

PLC-(#)	A/B CompactLogix 1769-L33ER, Or Approved Equal.	SCADA CONTRACTOR
POWER SUPPLY	A/B 1769-PA4 Power Supply, Quantity as required, Or Approved Equal.	SCADA CONTRACTOR
D.I. CARD	A/B #1769-IA8I, Or Approved Equal. Quantity as required.	SCADA CONTRACTOR
D.O. CARD	A/B#1769-OW8I, Or Approved Equal. Quantity as required	
A.I. CARD	A/B #1769-IF4I, Or Approved Equal. Quantity as required	SCADA CONTRACTOR
A.O. CARD	A/B#1769-OFCI, Or Approved Equal. Quantity as required	SCADA CONTRACTOR
PULSE INPUT CARD	A/B#1769-HSC, Or Approved Equal. Quantity as required	SCADA CONTRACTOR
UPS, 1200VA, 120VAC	Falcon, Sola HD, APC, Or Approved Equal.	SCADA CONTRACTOR
Fiber Patch Panel	8-port configuration by Cisco, or Approved Equal.	SCADA CONTRACTOR
16RJ-45 Ports, 2-single mode fiber optic ports.	Extreme Networks, Or Approved Equal.	SCADA CONTRACTOR

b. PLC MicroLogix Panels (As shown on the Network Diagram)

PLC-(#)	A/B Micrologix 1400 w/20-DI, 12-DO relays	SCADA CONTRACTOR
POWER SUPPLY	Phoenix 24VDC 10A	SCADA CONTRACTOR

D.I. CARD	A/B #1769-IA16 PT	SCADA CONTRACTOR
Optical Signal <i>Isolator</i>	Phoenix	SCADA CONTRACTOR
A.I./A.O. CARD	A/B # 4PT Voltage / 4-20mA	SCADA CONTRACTOR
UPS, 1200VA, 120VAC	Falcon, Sola HD, APC, Or Approved Equal.	SCADA CONTRACTOR
Fiber Patch Panel	8-port configuration by Cisco, or Approved Equal.	SCADA CONTRACTOR
16RJ-45 Ports, 2-single mode fiber optic ports.	Extreme Networks, Or Approved Equal.	SCADA CONTRACTOR

c. Remote I/O Panels (As shown on the Network Diagram)

POWER SUPPLY	A/B 1769-PA4 Power Supply, Quantity as required, or equal by Phoenix Contact.	SCADA CONTRACTOR
REMOTE I/O	Remote I/O Adaptor A/B#1794-AENT	SCADA CONTRACTOR
REMOTE I/O	Analog Input Module A/B#1794-IF4I	SCADA CONTRACTOR
REMOTE I/O	Analog Output Module A/B#1794-OF4I	SCADA CONTRACTOR
REMOTE I/O	Digital Input Module A/B#1794-IA16I	SCADA CONTRACTOR
REMOTE I/O	Digital Output Module A/B#1794-OA8I	SCADA CONTRACTOR
UPS, 1200VA, 120VAC	Falcon, Sola HD, APC, Or Approved Equal.	SCADA CONTRACTOR
Fiber Patch Panel	8-port configuration by Cisco, or Approved Equal.	SCADA CONTRACTOR
16RJ-45 Ports, 2-single mode fiber optic ports.	Extreme Networks, Or Approved Equal.	SCADA CONTRACTOR

d. Network/Ethernet Switch Panels (As shown on the Network Diagram)

UPS, 1200VA, 120VAC	Falcon, Sola HD, APC, Or Approved Equal.	SCADA CONTRACTOR
Fiber Patch Panel	8-port configuration by Cisco, or Approved Equal.	SCADA CONTRACTOR

16RJ-45 Ports, 2-single mode fiber optic ports.	Extreme Networks, Or Approved Equal.	SCADA CONTRACTOR
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2.4 REQUIRED I/O FOR EACH PLC LOCATION:

- A. As shown on the plan sheets (See the P&ID drawings for all I/O and functionality).
- B. In addition to the I/O and data shown on the plan sheets, the following I/O and data shall be gathered by the SCADA system and made available at the HMI system for each of the types of devices or processes indicated:
 1. General SCADA PLC
 - a. TVSS Health
 - b. Power Supply Status
 - c. Enclosure Door Status
 - d. PLC to HMI system Handshake
 2. Pump Motor Variable Frequency Drives
 - a. Data age
 - b. Comms Health
 - c. Voltage Input/Output per phase and line to line
 - d. Current per phase
 - e. Power – instantaneous and totalized over 24 hr period
 - f. Remote Fault Reset
 - g. Thermal OL indication
 - h. Seal Fail
 - i. Seal Fail Override
 3. Pump Motor Soft Starters
 - a. Data age
 - b. Comms Health
 - c. Voltage Input/Output per phase and line to line
 - d. Current per phase
 - e. Power – instantaneous and totalized over 24 hr period
 - f. Remote Fault Reset
 - g. Thermal OL indication
 - h. Seal Fail
 - i. Seal Fail Override
 4. Pump Motor Full-Voltage, Non-reversing Starters

- a. Data age
 - b. Comms Health
 - c. Current per phase
 - d. Remote Fault Reset
 - e. Thermal OL indication
 - f. Seal Fail
 - g. Seal Fail Override
5. Flow Meters
- a. Data Age
 - b. Flow Rate
 - c. Fault
 - d. Current Total 24 HRS
 - e. Total Previous Day
 - f. Total Non-reset
 - g. Rate of Change
6. Level Sensors
- a. Data Age
 - b. Fault
 - c. Operating Set Point
 - d. Low Level Set Point
 - e. High Level Set Point
 - f. Rate of Change
 - g. Physical High Level Mark – For reference.
7. Open/Close Valve Operators
- a. Comms Health
8. Modulated Valve Operators
- a. Hand Override Position Indication
 - b. Elapsed Time Operator was in Hand Override Mode
 - c. Comms health
9. Pressure Sensor
- a. Pressure Status
10. Generator
- a. Comms Health
 - b. Generator Running

- c. Generator Failed
- d. Generator Fuel Alarm
- 11. Automatic Transfer Switch
 - a. Comms Health
 - b. ATS in Normal Power
 - c. ATS in Emergency Power

2.5 PROGRAMMING SOFTWARE

- 1. The Software shall be RS Logix 5000 and shall be programmed as required by the system integrator.

2.6 MANUFACTURERS

A. PLC

- 1. As manufactured by Allen-Bradley.
- 2. Or Approved Equal.

B. Input/Output Modules

- 1. Components as manufactured by Allen-Bradley.
- 2. Or Approved Equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Install the work of this Section in strict accordance with the original design and the manufacturer's recommended installation procedures as approved by the ENGINEER, anchoring all components firmly into position for long life under hard use
- B. Unload, unpack and transport equipment to prevent damage or loss.
- C. Replace damaged components as directed by ENGINEER.
- D. Protect from dust and other harmful materials.
- E. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Provide all required cables, cords, and connective devices for interface with other control system components.
- B. Coordinate size and configuration of enclosure to meet project requirements.

3.4 STARUP SERVICE

- A. Upon final completion of all components determine date of start-up jointly with ENGINEER, OWNER and CONTRACTOR.

3.5 CLEANING

- A. Clean units as recommended by manufacturer.

END OF SECTION 25 50 00



DIVISION 26- ELECTRICAL

SECTION 26 05 00 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This division of the Specifications, Division 26 000, covers the complete interior and exterior electrical systems as indicated on the drawings or as specified herein. Provide all materials, labor, equipment and supervision to install electrical systems.

1.03 QUALITY ASSURANCE

- A. All electrical work shall be in accordance with the following codes and agencies:
 - 1. The National Electrical Code (NFPA 70) – 2017.
 - 2. The National Electrical Safety Code (ANSI C-2)
 - 3. The Life Safety Code (NFPA 101)
 - 4. The International Building Code
 - 5. Occupation Safety and Health Administration (OSHA)
 - 6. Manufacturer's written requirements.
 - 7. Regulations of the local utility company with respect to metering and service entrance.
 - 8. Municipal and state ordinances governing electrical work.
- B. Material Standards: All material shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and Standards of the organization listed below are applicable to materials specified herein.
 - 1. American Society for Testing and Materials (ASTM)
 - 2. Underwriters' Laboratories, Inc. (UL)
 - 3. National Electrical Manufacturer Association (NEMA)
 - 4. Insulated Cable Engineers Association (ICEA)
 - 5. Institute of Electrical and Electronic Engineers (IEEE)
 - 6. National Fire Protection Association (NFPA)
 - 7. American National Standards Institute (ANSI)
 - 8. Manufacturer's Written Requirements

1.04 PERMITS

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.05 WARRANTY

- A. For warranty of work under Division 16, refer to the GENERAL CONDITIONS.

1.06 DRAWINGS

- A. The drawings indicate the arrangements of electrical equipment. Review architectural drawings for door swings, cabinets, counters and built-in equipment; conditions indicated on architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness.
- B. Do not scale drawings. Obtain dimensions for layout of equipment from Architectural plans and existing conditions unless indicated on Electrical plans.
- C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.
- D. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the job differs from layout, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

1.07 SUBMITTALS:

- A. Shop Drawings and Product Data:
 - 1. The Contractor shall submit for review by the Engineer data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Provide complete electrical characteristics for all equipment. Submittals for lighting fixtures shall include Photometric data.
 - 2. Refer to the individual sections for identified equipment and materials for which submittals are required.
 - 3. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES section for required procedures.
- B. Record Documents
 - 1. Refer to Division 1 for record documents and related submittals.

1.08 OPERATION AND MAINTENANCE DATA AND INSTRUCTIONS

- A. Refer to Division 1 for detail requirements.
- B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.
- C. Instructions of Owner Personnel:
 - 1. Before final inspection, as designated by the Engineer provide a competent representative to instruct Owner's designated personnel in systems under this division of the specifications.
 - 2. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
 - 3. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.09 EQUIPMENT REQUIRING ELECTRICAL SERVICE

- A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service. Refer to ELECTRICAL CONNECTIONS FOR EQUIPMENT section for connection requirements.
- B. Drawings indicate design loads and voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the Owner. Such adjustment shall be subject to the review of the Engineer.
- C. Incidental items not indicated on Drawings or mentioned in Specifications but that can legitimately and reasonably be inferred to belong to the Work or be necessary in good practice to provide a complete system, shall be furnished and installed as though itemized here in detail. This includes connection requirements for air conditioning and refrigeration equipment as outlined by NEC Article 440.

1.10 SCHEDULING OF OUTAGES

- A. Electrical work requiring interruption of electrical power which would adversely affect the normal operation of the other portions of the Owner's property, shall be done at time other than normal working hours. Normal working hours shall be considered eight A.M. to five P.M. Monday through Friday.
- B. Schedule all work requiring interruption of electrical power two weeks prior to actual shutdown. Submit schedule in writing indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the approval of the Engineer and the Representative of the Owner.

1.11 SITE INVESTIGATION

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project.

PART 2- BASIC MATERIALS**2.01 MATERIALS**

- A. All materials shall be new.
- B. Furnish all materials specified herein or indicated on the drawings.
- C. Materials of the same type shall be the product of one manufacturer.

- D. All materials shall be UL listed and shall bear UL label. ETL listed material shall bear ETL label. ETL label shall be accepted in lieu of UL when the UL testing standards have been followed.

PART 3 - DISTRIBUTION PRODUCTS

3.01 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Inspect materials upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material. Handle materials in accordance with manufacturer's applicable standards and suppliers recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises.
- B. All material, except items specifically designed to be installed outdoors such as pad mounted transformers or stand-by generators, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided by the Contractor. Provide temperature and/or humidity control where applicable. No material for installation, including conductors, shall be stored other than in an enclosed weathertight structure. Equipment stored other than as specified above shall be removed from the premises.
- C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat and high humidity at all times. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.02 CLEANING AND PAINTING

- A. Remove oil, dirt, grease and foreign materials from all raceways, fittings, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touchup scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.
- B. Do not paint trim covers for flush mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinets unless required by the Engineer, National Electrical Code or other Sections of the specifications. Remove trim covers before painting. Under no conditions shall locks, latches or exposed trim clamps be painted.
- C. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.
- D. Where plywood backboards are used to mount equipment provided under Division 26, paint backboards with two coats of light grey semi-gloss paint under Division 26.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform all excavation to install conduits, indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. Provide shoring as required by OSHA Standards. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping. Do all excavation by open cut. No tunneling shall be done unless indicated on the drawings or unless written permission is received from the engineer.
- B. Grade the bottom of trenches to provide uniform bearing and support for conduits on undisturbed soil at every point along its entire length. Tamp overdepths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.
- C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. Backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface to grade and compaction indicated on the drawings, mounded over and smoothed off.
- D. Provide plastic tracable marking tape above all exterior conduits 12" below grade.

3.04 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE.

- A. Testing
 - 1. Refer to the individual specification sections and the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of the specifications for test requirements.
 - 2. Prior to the final inspection, the systems or equipment shall be tested and reported as therein specified. Five (5) typewritten copies of the tests shall be submitted to the Engineer for approval.
 - 3. All electrical systems shall be tested for compliance with the specifications.
- B. Manufacturers Certifications
 - 1. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been reviewed by the manufacturer is installed in accordance with the manufacturer's recommendations and is operating in accordance with the specifications.
 - 2. Provide manufacturers certification for the following systems:
 - a. Engine Driven EPSS
- C. Design Authority Assistance

1. The Contractor shall provide personnel to assist the Engineer or his representative during all construction review visits. The Contractor shall provide all necessary tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, radios, etc.
2. Remove equipment covers (i.e. panelboard trims, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.
3. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed by the Representative.
4. The Contractor shall provide authorized representatives of the manufacturers to demonstrate to the Engineer compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the Engineer. Refer to the specific specification section for additional testing requirements. Representatives of the following systems are required for demonstrations:
 - a. Engine Driven EPSS

END OF SECTION 26 05 00

SECTION 26 05 19 – WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of furnishing, installation and connections of the building wiring system, 600 volts and below. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. Wiring systems for communication and alarm systems are not included in this section unless specified to be included, by reference, in the respective specification sections for alarm and communication systems.

1.03 QUALITY ASSURANCE

- A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 44: Rubber - Insulated Wire and Cables
 - b. No. 83: Thermoplastic - Insulated Wires
 - c. No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
 - d. No. 486: Wire Connectors and Soldering Lugs
 - 2. Insulated Cable Engineers Association Standards (ICEA):
 - a. S-61-402: Thermoplastic Insulated Wire and Cable
 - 3. National Electrical Manufacturer's Standards (NEMA):
 - a. WC-5: Thermoplastic Insulated Wire and Cable
 - 4. National Fire Protection Association Publication (NFPA):
 - a. No. 70: National Electrical Code (NEC)
- B. Acceptable Manufacturers. Products produced by the following manufacturers which conform to this specification are acceptable.
 - 1. Hydraulically applied conductor terminations:
 - a. Square D
 - b. Burndy
 - c. IlSCO
 - d. Scotch (3M)
 - e. Thomas and Betts (T&B)
 - f. Anderson
 - 2. Mechanically applied (crimp) conductor terminations:
 - a. Scotch (3M)
 - b. Ideal
 - c. Thomas and Betts (T&B)
 - d. Burndy
 - 3. Vinyl electrical insulating tape:

- a. Scotch (3M)
 - b. Tomic
 - c. Permacel
- 4. Twist-On Wire Connectors:
 - a. Scotch (3M)
 - b. Ideal
 - c. Buchanan
- 5. Encapsulated insulating kits:
 - a. Scotch (3M)
 - b. Raychem
 - c. Essex Group, Inc.
- C. Performance: Conductors shall be electrically continuous and free from short circuits or grounds. All open, shorted or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

PART 2- PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Provide all materials under this section of the specifications.
- B. All wire and cable shall be UL listed and shall bear a UL label along the conductor length at intervals not exceeding 24 inches.
- C. All conductors shall have size, grade of insulation, voltage and manufacturer's name permanently marked on the outer cover at intervals not exceeding 24 inches.
- D. Conductor size shall be a minimum of No. 12 AWG. Conductor size shall not be less than indicated on the drawings.
- E. Insulation voltage level rating shall be 600 volts.

2.02 PRODUCT/MATERIALS DESCRIPTION

- A. Conductors No. 10 AWG and smaller shall be solid copper, 90°C. type THHN, THWN or XHHW unless otherwise indicated on the drawings, required by the National Electrical Code, or specified elsewhere in Division 16. Where fixtures are used as raceway use 90°C type THHN or XHHN conductors.
- B. Conductors larger than No. 10 AWG shall be stranded copper, 90°C., type THHN/THWN, XHHW, unless otherwise indicated on the drawings, required by the National Electrical Code, or specified herein.
- C. Fixture wire shall be No. 16 AWG silicone rubber insulated, stranded fixture wire, type SFF-2 (150°C), or No. 16 AWG thermoplastic, nylon jacketed stranded fixture wire, type TFFN (90°C). Color code as specified herein shall not be required for fixture wire; however, neutral conductor shall be identified distinctly from phase conductors.
- D. Control conductors for use on 120 volt control wiring systems shall be No. 12 AWG stranded type THHN/THWN, unless indicated otherwise on the drawings.

- E. Splices and taps (No. 10 AWG and smaller) - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600 volt, 105°C. with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.
- F. Splices and taps (No. 8 and larger) - Hydraulically applied crimping sleeve or tap connector sized for the conductors or indent, split-bolt or bolt clamp-type connectors. Insulate the hydraulically applied connector with 90°C., 600 volt insulating cover provided by the connector manufacturer. Insulate the mechanically applied connectors with heat shrink insulator sleeve or plastic electrical insulating type. Insulator materials and installation shall be approved for the specific application, location, voltage and temperature and shall not have an insulation value less than the conductors being joined.
- G. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295.

2.03 VFD CABLE

- H. All feeders for motors controlled by variable frequency drives shall be served with cable specifically manufactured to mitigate the EMI and RFI effects on adjacent cables and/or conductors.
- I. Acceptable manufacturers: Lapp Group USA, Belden and Alpha Wire.
- J. Required characteristics for VFD power cable:
 - 1. Class B stranded copper or tinned copper conductors with XLP/XLPE insulation.
 - 2. Three bare copper ground conductors or integral with the cable.
 - 3. Spiral or helical copper tape for 100% shield.
 - 4. 1000V minimum rating.
 - 5. 90°C, wet or dry installation, approved for direct burial, TC-ER approved.
 - 6. PVC outer jacket.

PART 3 - EXECUTION

3.01 EXECUTION

- A. Install all wiring in raceway system.
- B. Connect all conductors. Torque each terminal connection to the manufacturers recommended torque value. A calibrated torqueing tool shall be used to insure proper torque application. Any conductors nicked or ringed while removing insulation shall be replaced.
- C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. A maximum of two branch circuits are to be installed in any one conduit, on 1 phase 3 wire systems, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings.

- D. Conductors shall be tested to be continuous and free of short circuits and grounds.
- E. Identification
 - 1. Conductors within pull boxes shall be grouped and identified with nylon tie straps with circuit identification tag.
 - 2. Identify each control conductor at its terminal points with wrap around tape wire markers. I.D. to indicate terminal block and point designation, or other appropriate identifying indication.
 - 3. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional identification requirements.
- F. Color Code Conductors.
 - 1. Color code all secondary service, feeder and branch circuit conductors. Control and signal system conductors need not be color coded.
 - 2. Coding shall be as follows:
 - a. 208Y/120 volt three phase four wire wye system - Phase A: Black, Phase B: Red, Phase C: Blue, Neutral: White
 - b. 480Y/277 volt three phase four wire system - Phase A: Brown, Phase B: Orange, Phase C: Yellow, Neutral: Gray
 - c. 240/120 volt single phase 3 wire system - Phase A: Black, Phase B: Red, and Neutral: White
 - 3. Grounding conductors shall be green.
 - 4. Conductors No. 6 and smaller shall have solid color compound insulation or continuous color finish. Conductors No. 4 and larger shall have colored phase tape. Colored tape shall be installed on conductors in every box, at each terminal point, cabinet, through manhole or other enclosure.
- G. Maintain phase rotation established at service equipment throughout entire project.
- H. Group and lace with nylon tie straps all conductors within enclosures, i.e. panels, motor controllers, motor control center, switchboard, switchgear, terminal cabinets and control cabinets.
- I. Make splices in conductors only within junction boxes. Do not splice conductors in pull boxes, panelboards, safety switches, switchboard, switchgear, motor control center, wiring troughs or motor control enclosures.
- J. Terminate conductors No. 10 AWG and smaller specified in Division 16 to be stranded, with crimp type lug or stud. Direct termination of stranded conductors without crimp terminator to terminal screws, lugs, or other points is not permitted even if terminal is rated for stranded conductors. Crimp terminal shall be the configuration type suitable for terminal point. Crimp lugs shall be applied in strict accordance with the manufacturer's written requirements.
- K. Make connections between fixture junction box and fixture with fixture wire.
- L. Control, communications or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceway, unless indicated otherwise on the drawings.
- M. Splices in conductors installed below grade are not permitted.

- N. VFD cable shall be terminated in accordance with manufacturer's recommendations. For Belden cable refer to Belden Unarmored Variable Frequency Drive (VFD) Cable Termination Guide.

END OF SECTION 26 05 19

SECTION 26 05 26 – SECONDARY GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of furnishing, installation and connections of the building secondary grounding systems. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be a 3 phase, 4 wire grounded wye system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.03 QUALITY ASSURANCE

- A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 44: Rubber - Insulated Wire and Cables
 - b. No. 83: Thermoplastic - Insulated Wires
 - c. No. 467: Electrical Grounding and Bonding Equipment
 - d. No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
 - e. No. 486: Wire Connectors and Soldering Lugs
 - 2. National Electrical Manufacturer's Standards (NEMA):
 - a. WC-5: Thermoplastic Insulated Wire and Cable
 - b. WC-7: Cross-Linked-Thermosetting Polyethylene Insulated Wire and Cable
 - 3. National Fire Protection Association Publication (NFPA):
 - a. No. 70: National Electrical Code (NEC)
- B. Acceptable Manufacturers. Products produced by the following manufacturer which conform to this specification are acceptable.
 - 1. Hydraulically applied conductor terminations:
 - a. Square D
 - b. Burndy
 - c. IlSCO
 - d. Scotch (3M)
 - e. Thomas and Betts (T & B)
 - f. Anderson
 - 2. Mechanically applied (crimp) conductor terminations:
 - a. Scotch (3M)
 - b. Ideal
 - c. Thomas and Betts (T & B)
 - d. Burndy
 - 3. Exothermic connections:

a. Cadweld

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Provide all materials under this section of the specifications. All materials shall be new.
- B. All materials shall be UL listed and bear a UL label.
- C. Refer to the specific specification section for the description and requirements of materials mentioned herein for installation.

2.02 GROUNDING CONDUCTORS

- A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the drawings.
- B. Equipment grounding conductors shall be green insulated type THW, THWN, or XHHN conductors sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.
- C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.03 TRANSFORMERS, MOTOR CONTROLLERS, AND DISCONNECT SWITCHES

- A. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.04 DEVICES

- A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.05 GROUND RODS

- A. Ground rods shall be 3/4" x 10'-0" copper clad steel.
- B. Sectional ground rods shall be hot dip galvanized 5/8" x 10' sections with an internal stainless steel splined coupling pin.

2.06 OTHER MATERIALS

- A. Ground bus shall be solid copper, 1/4" thick x 2" x 24", tapped and drilled for conductor termination lug connections.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.
- B. Service entrance and separately derived electrical systems, grounding electrode system.
 - 1. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in galvanized rigid steel. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.
 - 2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity. Install a bonding jumper of the same size as the grounding conductor around the water meter.
 - 3. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.
 - a. Cold water piping system
 - b. Ground rod system
 - c. Main rebar in a foundation footing, for a concrete structure
 - 4. Ground the neutral of all dry type transformers to building steel which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. Make connection to building steel with an exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.
 - 5. Ground the neutral and frame of the emergency generator to building steel and the ground rod system, which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. Make connection to building steel with an exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.
 - 6. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.
 - 7. Where more than one service serves a building or interconnected buildings, connect each service equipment ground bus together with a #4/0 copper conductor in PVC conduit.
 - 8. Bonding shall be in accordance with the National Electrical Code.
 - 9. Install ground rods where indicated on the drawings with the top of the ground rods 12" below finished grade.
- C. Equipment Grounding Conductor

1. Grounding conductors for branch circuits are not shown on the drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables. Grounding conductors shall be the same AWG size as branch circuit conductors.
2. Grounding conductors for feeders are typically indicated on the drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.
3. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.
4. A feeder serving several panelboards shall have a continuous grounding conductor which shall be connected to each related cabinet grounding bar.
5. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tool.
6. Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with crimping tool.
7. Equipment grounding conductors shall terminate on panelboard, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus. Provide a single terminals lug for each conductor. Conductor shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

D. Other Grounding Requirements

1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the "point of grounding" of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as "point of grounding". Terminate conductor by stapling to backboard.
2. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by exothermic weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.
3. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.

3.02 TESTING

- A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within forty-eight hours of rainfall. Results of ground resistance readings shall be forwarded, in writing, immediately to the Engineer.

END OF SECTION 26 05 26

SECTION 26 05 29 – SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division - 16 sections.
- B. Types of supports, anchors, sleeves and seals specified in this section include the following:
 - 1. Clevis hangers.
 - 2. Riser clamps.
 - 3. C-clamps.
 - 4. I-beam clamps.
 - 5. One-hole conduit straps.
 - 6. Two-hole conduit straps.
 - 7. Round steel rods.
 - 8. Expansion anchors.
 - 9. Toggle bolts.
 - 10. Wall and floor seals.
- C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment are specified as part of that equipment assembly in other Division - 16 sections.
- D. Provide seismic supports for electrical equipment as required by occupancy. Refer to structural and architectural drawings for criteria.

1.03 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.
- B. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
- C. UL Compliance: Provide electrical components which are UL-listed and labeled.

PART 2- PRODUCTS

2.01 MANUFACTURED SUPPORTING DEVICES

- A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

- B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
1. Conduit clamps, clevis hangers, round steel rod, conduit clamps, heagon nuts, etc. shall be stainless steel.
- C. Anchors: Provide anchors of types, sizes and materials indicated, with the following construction features:
1. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 lbs. per 100 units.
 2. Expansion sleeve anchors by Hilti or Phillips Redhead: 1/2"; approximately 38 lbs. per 100 units.
 3. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:
 - a. Ackerman Johnson Fastening Systems Inc.
 - b. Hilti
 - c. Ideal Industries, Inc.
 - d. Joslyn Mfg and Supply Company
 - e. McGraw Edison Company
 - f. Phillips Redhead
 - g. Rawlplug Company Inc.
- D. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:
1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- E. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable-iron casting with hot-dip galvanized finish.
- F. U-Channel Strut Systems:
1. The approved material for u-channel strut, hardware and associated items will be either stainless steel or aluminum.
 - a. Fixture hangers.
 - b. Channel hangers.
 - c. End caps.
 - d. Beam clamps.
 - e. Wiring studs.
 - f. Thinwall conduit clamps.
 - g. Rigid conduit clamps.
 - h. Conduit hangers.
 - i. U-bolts.
 2. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:
 - a. Allied Tube and Conduit Corporation.
 - b. B-Line Systems, Inc.
 - c. Elcen Metal Products Company.

- d. Greenfield Mfg Company, Inc.
- e. Midland-Ross Corporation.
- f. OZ/Gedney Div; General Signal Corporation.
- g. Power-Strut Div; Van Huffer Tube Corporation.
- h. Unistrut Div; GTE Products Corporation.

2.02 FABRICATED SUPPORTING DEVICES

- A. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14" gage.
 - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
 - 3. Iron Pipe: Fabricate from cast-iron or ductile-iron pipe.
 - 4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.
- B. Sleeve Seals: Provide modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES

- A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.
- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports in compliance with NEC requirements.
- D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.
- E. Remove burrs from ends of pipe sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section covers the complete interior and exterior raceway system.
- B. Definition: The term conduit, as used in this Specification, shall mean any or all of the raceway types specified.

1.03 QUALITY ASSURANCE

- A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - No. 1 Flexible Metal Electrical Conduit
 - No. 6 Rigid Galvanized Conduit
 - N. 6a Stainless Steel Rigid Conduit
 - No. 467 Electrical Grounding and Bonding
 - No. 651 Rigid Nonmetallic Electrical Conduit
 - No. 797 Electrical Metallic Tubing
 - No. 1242 Intermediate Metal Conduit
 - 2. American National Standards Institute (ANSI):
 - C-80.1 Rigid Galvanized Conduit.
 - C-80.3 Electrical Metallic Tubing.
 - 3. National Fire Protection Association (NFPA):
 - No. 70 National Electrical Code (NEC).
- B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
 - 1. Metallic Conduit Fittings:
 - a. Appleton
 - b. Carlon
 - c. Crouse Hinds
 - d. Killark
 - e. O-Z/Gedney
 - f. RACO
 - g. Thomas and Betts
 - h. CalPipe Industries
 - i. Gibson Stainless
 - 2. Support Channel:
 - a. Kindorf
 - b. Powers
 - c. Unistrut
 - 3. Non-Metallic Conduit and Fittings:

- a. Carlon
 - b. Certainteed
 - c. Thomas and Betts
- C. Coordination
 - 1. Coordinate conduit installation with electrical equipment furnished.
 - 2. Coordinate conduit installation with contract documents and other contractors. Adjust installation to eliminate conflicts. Review all shop drawings submitted under this and other sections to insure coordination with all equipment requiring electrical service and to avoid conflict interferences. Coordinate installation sequence with other contractors to avoid conflicts including equipment access and provide the fastest overall installation schedule.

1.04 STORAGE AND HANDLING

- A. Refer to the BASIC ELECTRICAL REQUIREMENTS section of the specifications for storage and handling requirements.
- B. Non-metallic conduits stored on site prior to installation shall be stored on a surface off of the ground and shall be protected from the direct rays of the sun and from debris.
- C. Damaged, oxidized, warped, improperly stored material or material with excessive amounts of foreign debris will be removed from the project and replaced with new materials.

PART 2- PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Furnish all materials specified herein.
- B. All conduit and fittings shall be listed and bear a label by Underwriters' Laboratories (UL) for use as raceway system for electrical conductors.
- C. Raceway is required for all wiring, unless specifically indicated or specified otherwise.
- D. Size: The minimum size of conduit shall be 3/4". The size of all conduits shall be in accordance with the NEC, but, not less than indicated on the drawings.

2.02 EMT CONDUIT FITTINGS

- A. Electrical Metallic Tubing (EMT) couplings and connectors shall be steel "concretetight" type. Malleable iron, die cast or pressure cast fittings are not permitted. Fittings 2.0" and smaller shall be gland and ring compression type. Connectors for conduits 2.5" and larger shall be set screw type with two (2) screws each or compression type. Couplings for conduits 2.5" and larger shall be set screw type with four (4) screws each or compression type. All connectors shall be insulated throat type. All set screw connectors encased in walls or floor shall be taped at all joints.

2.03 STAINLESS STEEL, ALUMINUM, RIGID AND IMC CONDUIT FITTINGS

- A. Fittings for stainless steel, aluminum, rigid steel and IMC shall be standard threaded couplings, threaded hubs and elbows. All materials shall be steel or malleable iron only.

Set screw or non-thread fittings are not permitted. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings. Erickson-type couplings may be used to complete a conduit run.

2.04 NON-METALLIC CONDUIT AND FITTINGS

- A. Non-metallic conduit shall be schedule 80 PVC.
- B. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer.
- C. Glue for all non-metallic conduit and fittings shall be provided as required by the manufacturer of the conduit being used.

2.05 CONDUIT SUPPORTS

- A. Support channel and rods shall be stainless or aluminum.
- B. Conduit straps shall be single hole cast metal type or two hole galvanized metal type.
- C. Conduit support channels shall be 1.5" x 1.5" x 14 gauge galvanized (or with equivalent treatment) channel. Channel suspension shall be 3/8" threaded steel rods. Use swivel type connector to attach suspension rods to structure. Spring steel clips are not acceptable. Wire or chain is not acceptable for conduit hangers. Stainless steel channels, fasteners and conduit straps shall be used on all exterior installations.
- D. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose, sized appropriately for the conduit type and diameter, and have pre-assembled closure bolt and nut and provisions for receiving threaded hanger rod. Support with 1/4" threaded steel rod for individual conduits 1.5" and smaller and 3/8" rod for individual conduits 2.0" and larger.
- E. Refer to SUPPORTING DEVICES section of these specifications for additional material requirements.

2.06 FLEXIBLE CONDUIT AND FITTINGS

- A. Flexible conduit shall be steel metallic type. Where specified herein, indicated on the drawings, or when used in damp or wet locations, as classified by the National Electrical Code, flexible conduit shall be liquid tight.
- B. All flexible conduit shall be classified as suitable for system grounding. All flexible (liquid tight) conduits shall be UL listed as sunlight (UV) resistant.
- C. Connectors for flexible conduit shall be steel insulated throat type rated as suitable for system ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.
- D. Flexible conduit shall not be less than 3/4" trade size and in no case shall flexible conduit size be less than permitted by the National Electrical Code for the number and size of conductors to be installed herein.

2.07 MISCELLANEOUS CONDUIT FITTINGS AND ACCESSORIES

- A. Vinyl all weather electrical tape for corrosion protection shall be Scotch Temflex
- B. Expansion and deflection couplings shall be in accordance with UL 467 and UL 514. They shall accommodate 3/4" deflection, expansion, or contraction in any direction and shall allow 30 degree angular deflections. Couplings shall contain an internal flexible metal braid to maintain raceway system ground continuity.
- C. Fire and smoke stop materials shall be rock wool fiber, silicone foam, or silicone sealant, UL rated to maintain the fire floor or fire wall partition rating.

2.08 RIGID ALUMINUM CONDUIT FITTINGS

- A. Rigid aluminum conduit fittings shall be standard threaded couplings, locknuts, bushings, and elbows. Material shall be compatible with aluminum conduit of malleable iron, steel or aluminum alloy. Iron or steel fittings shall be zinc or cadmium plated. Aluminum fittings shall not contain more than 0.4 percent copper. Threaded hubs shall be as specified for rigid steel and IMC conduit. Set screw fittings or no-thread fittings are not acceptable.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. General
 - 1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings.
 - 2. Leave all empty conduits with a 200 pound test nylon cord pull line.
 - 3. Install as complete raceway runs prior to installation of cables or wires.
 - 4. Flattened, dented, burned, or deformed conduits are not permitted and shall be removed and replaced.
 - 5. Secure rigid conduit i.e., rigid galvanized conduit, rigid aluminum conduit and intermediate metal conduit, to sheet metal enclosures with threaded hubs. Secure EMT to sheet metal enclosures with insulated throat connectors with lock nut.
 - 6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on metal studs. Nails are not acceptable.
 - 7. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage; any damaged conduits shall not be used.
 - 8. Seal all conduits originating from outside building from below grade and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture. Spray foam is not acceptable.
 - 9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
 - 10. Use flexible conduit for connection to vibrating equipment and rotating machinery and for connection from junction box to flush mounted lighting fixtures only.

11. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise on the drawings.
12. Provide expansion fitting in all conduits where length of run exceeds 200 feet or where conduits pass building expansion joints.

B. Uses Permitted

1. Conduits installed within concrete floor slabs which are in direct contact with grade or other material shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits which penetrate the building roof shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits installed within concrete floor slabs which are above grade shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC), or schedule 80 Heavy Wall PVC. Where transition is made from raceway in slab to any type of raceway out of slab, make transition with rigid galvanized elbow. For corrosion protection, where elbow penetrates surface, apply two coats of Scotchrap pipe primer and two overlapping layers of Scotchrap Temflex tape, for 6" above and below concrete surface. For exposed conduits outside, provide aluminum or stainless steel. For exposed conduits inside, provide stainless, aluminum, RGC or IMC.
2. Conduits installed in direct contact with earth shall be schedule 80, heavy wall PVC.
3. Service entrance conduits in direct contact with earth shall be PVC. Other conduit in direct contact with earth shall be schedule 80, heavy wall PVC.
4. All other conduit, unless excluded herein, not permitted in accordance with the National Electrical Code, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT).
5. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the NEC.
6. Use flexible conduit for connections to motors, dry type transformers and unit heaters.
 - a. Flexible conduit used for connection of motors, dry type transformers, electric duct heaters, unit heaters, busway tap devices and voltage regulators shall not exceed 18" in length.
 - b. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
 - c. Liquid tight conduit shall be used to connect equipment in mechanical equipment rooms and exterior installations.
7. Feeder conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Service entrance conduits shall be installed "outside" of the building as defined by the NEC. Provide concrete encasement where required.
8. No conduit requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation. Conduits shall not be run horizontally in walls.
9. Rigid aluminum conduit may be used for all trade sizes 3.0" and larger for conduits not installed in concrete slabs, not installed in direct contact with earth, not installed in hazardous locations as defined by Article 500 of the National Electrical Code and not installed in areas exposed to excessive moisture.
10. All conduits installed exposed from the finished floor to a minimum height of 10 ft. above the floor shall be galvanized rigid steel (GRS) or aluminum.

11. Where hazardous locations, as classified by the National Electrical Code, exist, all conduits and fittings and the installation of these materials shall comply with Article 500 of the National Electrical Code.

C. Below Grade Raceway Installations

1. Direct Burial Conduit

- a. Install top of conduits 24" minimum below finished grade. Maximum depth shall be 36".
- b. Install top of conduits 6" minimum below bottom of building slabs.
- c. Install top of conduits 30" minimum below grade, below roads and any other paved surfaces.
- d. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, make transition with rigid galvanized elbow and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, apply two coats of Scotchrap pipe primer and two overlapping layers of Scotchrap Temflex tape, for 6" above and below concrete surface.
- e. For excavation and backfilling, refer to earthwork specification section.
- f. Conduit shall be run following the most direct route between points.

D. Raceway Installations Within Concrete

1. Conduit shall be run following the most direct route between points.
2. Conduit shall not be installed in concrete which is less than 3" thick or where the outside diameter is larger than 1/3 of the slab thickness.
3. Conduits installed in concrete slabs shall be buried in the concrete slab. Wire low conduits to upper side of the bottom reinforcing steel, and upper conduits to the lower side of the top reinforcing steel. Separate parallel runs of conduits within slab by at least 1".
4. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduits shall not be run directly below and parallel with load bearing walls.
5. Protect each metallic conduit installed in concrete slab or conduits 1.5" and smaller passing through a concrete slab against corrosion where conduit enters and leaves concrete by wrapping conduit with vinyl all-weather electrical tape.
6. The maximum projection of conduit stub-up and bushing above slab shall be 3" in equipment rooms.
7. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

E. Concealed (Above Ceilings and in Walls) and Exposed Raceway Installation

1. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
2. Support branch circuit conduits at intervals not exceeding 10 ft. and within three feet of each outlet, junction box, cabinet or fitting. Attach individual branch circuit conduits to structural steel members with beam conduit clamps and to non-metallic structural members with one hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hangar rod and conduit clamp assembly. Multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3. Attach feeder conduits larger than 1" trade diameter to or from structure on intervals not exceeding 12 ft. with conduit beam clamps, one hole conduit straps or trapeze type support in accordance with support systems described for branch circuit conduits.
4. Where conduits must pass through structural members, obtain approval of Engineer with respect to location and size of hole prior to drilling.
5. Install conduit sleeves in slabs where conduits 2.0" and larger pass through. Sleeves shall extent 1" minimum above finished slab. Seal all spare sleeves and between conduits and sleeves to make watertight.
6. Seal all conduit penetrations, sleeves and conduits penetrating chemical room walls and ceilings to prevent the migration of hazardous gases.
7. Conduits rigidly secured to building construction on opposite sides of a building expansion joint shall be provided with an expansion and deflection coupling. In lieu of an expansion coupling, conduits 2-1/2" and smaller may be provided with junction boxes on both sides of the expansion joint connected by 15" of slack flexible conduit with bonding jumper.

3.02 ADJUSTMENT, CLEANING AND PROTECTION

- A. Clean: Upon completion, clean all installed materials of paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

END OF SECTION 26 05 33

SECTION 26 05 33.01 – BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of the installation of outlet boxes, pull boxes, and junction boxes throughout the wiring system including box supports.
- B. Definition: Box, as used in this specification, includes all outlet, device, junction, and pull boxes. Feeder shall mean all conductor circuits larger than #8 AWG, including service entrance conductors, and all wiring above 600V.

1.03 QUALITY ASSURANCE

- A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 50: Electrical Cabinets and Boxes
 - b. No. 467: Electrical Grounding and Bonding Equipment
 - c. No. 514: Electrical Outlet Boxes and Fittings
 - 2. National Fire Protection Association (NFPA):
 - a. No. 70: National Electrical Code (NEC)
- B. Coordination: Review architectural drawings for areas where outlets occur within specific architectural or structural features and install outlets as shown on architectural drawings; or if not shown, accurately center and align boxes within the architectural features or detail.
- C. Acceptable Manufacturers:
 - 1. Exterior junction or pull boxes:
 - a. Quaztite: Type PG
 - b. Old Castle Synertech
 - c. Pencil

PART 2- PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Furnish all materials specified herein.
- B. All boxes shall be UL listed and labeled.
- C. Boxes shall be galvanized steel sheet metal, unless rustproof cast metal is specified or required by the NEC, or unless otherwise specified or indicated on the drawings.

2.02 OUTLET AND DEVICE BOXES

- A. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be 4" octagon boxes, 1-1/2" deep.
- B. Outlet boxes for flush mounted lighting fixtures shall be 4" square boxes 1-1/2" deep, with blank cover, installed adjacent to fixture. Connection to fixture shall be with flexible conduit and fixture wire.
- C. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be 4" square boxes, 1-1/2" deep with square edge tile type cover. Where only one conduit enters box, 3-1/2" deep single gang switch box may be used. Outlet boxes for GFI receptacles shall be 2-3/4" deep.
- D. Outlet boxes for switches and receptacles in exposed wiring system shall be cast FS boxes with matching device plate. Device plates for exterior installations shall be spring loaded hinged covers. Use FD box for GFI receptacle.
- E. Outlet boxes for individual switches, and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3-1/2" deep.
- F. Where special purpose device specified requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the installation required.
- G. Outlet boxes installed in poured concrete or cast in place shall be concrete-tight type. The box depth shall allow 2" minimum of concrete cover.

2.03 JUNCTION AND PULL BOXES

- A. Dimensions of pull boxes and junction boxes shall not be less than those dimensions required by the National Electrical Code for the number, size and position of conductors entering the box. Extension rings shall not be permitted on a box to increase the volume.
- B. Pull boxes installed in finished spaces shall be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match panel trim for flush mounted electrical panelboard.
- C. Pull boxes required for horizontal feeders containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" x 1-1/2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.
- D. Provide box covers for all junction and pull boxes.

2.04 EXTERIOR JUNCTION OR PULL BOXES, FLUSH WITH GRADE

- A. Junction or pull box to be mounted flush with grade shall be as indicated on the drawings. Provide polymer concrete, tier 22 traffic rated sized in accordance with the National Electrical Code minimum requirements. Covers shall be polymer concrete, tier 22 traffic rated with identifying system (i.e. Electrical) in cover secured to box with stainless steel bolts. Conduit entry shall be by field drilled openings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All boxes shall be completely accessible and as required by the NEC. Provide access panels in any non-accessible spaces to allow access to boxes installed. Crawling above ceilings to access boxes is not acceptable.
- B. Provide an outlet box for each lighting fixture and for each device. Boxes shall not be smaller than indicated in this section of the specifications and shall be larger if required by Article 314 of the National Electrical Code for the number and size of conductors installed. Where lighting fixtures are installed in continuous rows, only one outlet box shall be required.
- C. Outlet boxes for flush mounted lighting fixtures shall be accessible. Where fixture installation is in nonaccessible ceiling, outlet box shall be accessible when fixture is removed.
- D. Set outlet boxes for flush mounted devices to within 1/8" of finished wall. Spacers or shims between box and device are not acceptable. Modification of boxes or use of extension rings to provide for 1/8" of finished wall is not acceptable.
- E. Where low voltage device is to be installed in common outlet boxes with line voltage device, provide metal barrier within outlet box to establish two separate compartments.
- F. Where drawings indicate ganged installations of switches controlling 277 volt lighting circuits of opposite phase, separate switches with permanently installed nonmetallic barrier. Where space available for horizontal ganged installation is not adequate, install switches vertically to maintain required clearances between energized terminals.
- G. Support every box from structure:
 - 1. Secure to wood with wood screws.
 - 2. Secure to hollow masonry with toggle bolts.
 - 3. Secure to metal with sheet metal screws, machine bolts, or clamps.
 - 4. Anchors for solid masonry and concrete shall be self drilling expansion shields, insert expansion shields, or lead shields with machine bolts. Power actuated pin studs may be used in concrete.
 - 5. Secure outlet boxes to metal studs with spring steel clamp which wraps around entire face of stud and digs into both sides of stud. Clamp shall be screwed into stud.
 - 6. Where box is suspended below structure, support from structure with threaded steel rod. Secure rod directly to outlet boxes with double nuts. For pull boxes larger than 18" x 18" x 6", construct 1-1/2" x 1-1/2" x 14 gauge metal channel frame. Connect frame to box by bolting and secure frame to threaded rod at each corner.
 - 7. Hub type cast boxes need not be directly attached to structure if rigid conduit is used and supported in conformance with the NEC.
- H. Support outlet boxes for support of surface mounted incandescent lighting fixtures by light weight channel spanning between and attached to main ceiling support member. Attach channel to ceiling support members with galvanized tie wire or nylon tie straps.

- I. Do not use outlet boxes for support of lighting fixtures; boxes shall be used only as junction boxes.
- J. Remove only knockouts as required and plug all unused openings. Use threaded plugs for cast boxes and snap-in metal plugs for sheet metal boxes.
- K. Outlet boxes in the same wall shall not be mounted back-to-back. Offset 6" minimum.
- L. Install pull boxes only in unfinished spaces or concealed above ceilings, except when indicated on the drawings or approved by the Engineer.
- M. Install pull boxes when any of the following conditions apply:
 - 1. Where indicated on the drawings.
 - 2. Where conduit run exceeds 200 ft. from box to box or box to terminal.
 - 3. Where conduit contains more than 4-90 degree bends or the equivalent offsets.
 - 4. To facilitate conductor installation or to insure that the manufacturer's maximum pulling tension is not exceeded.
 - 5. As described in the RACEWAYS section of the specifications for crossing expansion joints.
- N. Do not splice conductors in pull boxes. Splices are not permitted in pull boxes except when approved in writing by the Engineer or where shown on the drawings. Where splices are permitted, make splices with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.
- O. Where a pull box is required, one shall be installed for each individual branch circuit conduit or each feeder. It shall contain only the feeder conductors or those conductors in the conduit. A combined pull box for multiple branch conduits or feeders is not permitted, unless approved by the Engineer or indicated on the drawings. Where permitted for multiple circuits within pull box:
 - 1. Circuit conductors and feeders shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each circuit and feeder within pull box. Identify each with respect to load served.
 - 2. Feeder circuits shall be wrapped, in accordance with manufacturer's recommendations, with arc-proof and fire proof tape.
- P. Box covers shall be in place and secured to box.
- Q. Identification
 - 1. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional requirements.
- R. Exterior pull or junction boxes
 - 1. Exterior pull or junction boxes shall be mounted flush with the grade, unless specified elsewhere or indicated to be aboveground on the drawings.
 - 2. Flush mounted boxes shall be surrounded on all sides and bottom with 6" minimum of concrete. Top of concrete shall be flush with grade.
 - 3. Seal conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

4. Taps and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

3.02 CLEANING AND ADJUSTMENT

- A. After completion, clean all work of dirt, paint and construction debris.

END OF SECTION 26 05 33.01

SECTION 26 05 33.02 – ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section include the following:
 - 1.To resistive heaters.
 - 2.From electrical source to motor starters.
 - 3.From motor starters to motors.
 - 4.To lighting fixtures.
 - 5.To transformers and similar current current adjustment features of equipment.
- C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division - 15 and other Division - 16 sections, and are work of this section.
 - 1. Division 1 - GENERAL REQUIREMENTS
 - 2. Division 11 - EQUIPMENT
 - 3. Division 13 - SPECIAL CONSTRUCTION
- D. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division - 16 sections, and are work of this section.
- E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division - 16 sections, and are work of this section.
- F. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.
- G. Electrical identification for wire/cable conductors is specified in Division - 16 section, ELECTRICAL IDENTIFICATION, and is work of this section.

1.03 QUALITY ASSURANCE

- A. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches. NEC Article 110-14, "ELECTRICAL CONNECTIONS" applies to above.
- B. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

- C. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
 - 1. ANSI/NEMA CC3: "Connectors for use between aluminum or aluminum-copper overhead conductors."
 - 2. ANSI/EIA RS-364-21A: "Insulation Resistance Test"
 - 3. STD SG-14: "Unplated split-bolt and Vice-Type Electrical Connectors for Copper Conductors".
- D. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.
 - 1. STD. NO. 486A; Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - 2. STD. No. 486B; Wire Connectors for Use with Aluminum Conductors.
 - 3. STD. NO. 486C; Splicing Wire Connectors.
 - 4. STD. NO. 486D; Insulated Wire Connectors for Use With Underground Conductors.
- E. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.
- F. ASTM Compliance: Comply with Standard B539 "Standard Methods for Measuring Contact Resistance of Electrical Connections (Static Contacts)."

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver electrical connection products wrapped in proper factory-fabricated type containers.
- B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.
- C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):
 - 1. AMP Incorporated
 - 2. Appleton Electric Company
 - 3. Arrow-Hart Div, Crouse-Hinds Company
 - 4. Bishop Div, General Signal Corporation
 - 5. Burndy Corporation
 - 6. General Electric Company
 - 7. Gould, Inc.
 - 8. Harvey Hubbell Inc.
 - 9. Ideal Industries, Inc.

10. Reliable Electric Company
11. Square D Company
12. Thomas and Betts Corporation

2.02 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Metal Conduit, Tubing and Fittings:
 1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division - 16 BASIC ELECTRICAL MATERIALS and RACEWAYS section, and in accordance with the following listing of metal conduit, tubing and fittings:
 - a. Rigid aluminum conduit
 - b. Rigid steel conduit
 - c. Rigid metal conduit fittings
 - d. Electrical metallic tubing
 - e. EMT fittings
 - f. Flexible metal conduit
 - g. Flexible metal conduit fittings
 - h. Liquid-tight flexible metal conduit
 - i. Liquid-tight flexible metal conduit fittings
 - j. Stainless steel conduits and fittings
- C. Wires, Cables, and Connectors:
 1. Provide wires, cables, and connectors complying with Division - 16 basic electrical materials and methods section "WIRES AND CABLES".
 2. Wires/Cables: Unless otherwise indicated, provided wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
 3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals which are recommended by equipment manufacturer for intended applications.
 4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Cover splices with electrical insulating material equivalent, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- E. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.
- H. Provide PVC conduit and fittings as indicated for highly corrosive atmospheres.
- I. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.
- J. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subject to one or more of the following conditions:
 - 1. Exterior location.
 - 2. Moist or humid atmosphere where condensate can be expected to accumulate.
 - 3. Corrosive atmosphere.
 - 4. Water spray.
 - 5. Dripping oil, grease, or water.
- K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division - 16 section ELECTRICAL IDENTIFICATION. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.02 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and

compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 26 05 33.02

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Extent of electrical identification work is as outlined by this specification.
- B. Types of electrical identification work specified in this section include the following:
 - 1. Buried cable warnings.
 - 2. Electrical power, control and communication conductors.
 - 3. Operational instructions and warnings.
 - 4. Danger signs.
 - 5. Equipment/system identification signs.
- C. Refer to Division 1 General Requirements section IDENTIFICATION SYSTEMS, for equipment and system nameplates, and performance data; not work of this section.

1.03 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.
- B. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- C. ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1, "Scheme for the Identification of Piping Systems".
- D. NEMA Compliance: Comply with applicable requirements of NEMA Std No's WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):
 - 1. Almetek
 - 2. Brady, W.H. Company
 - 3. Calpico Inc.
 - 4. Cole-Flex Corporation
 - 5. Direct Safety Company
 - 6. George-Ingraham Corporation
 - 7. Griffolyn Company
 - 8. Ideal Industries, Inc.
 - 9. LEM Products, Inc.

10. Markal Company
11. National Band and Tag Company
12. Panduit Corporation
13. Seton Name Plate Company
14. Tesa Corporation

2.02 ELECTRICAL IDENTIFICATION MATERIALS

- A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Color-Coded Plastic Tape:
 1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.
 - a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.
- C. Underground-Type Plastic Line Marker:
 1. Manufacturer's standard permanent, detectable, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
- D. Cable/Conductor Identification Bands:
 1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.
- E. Plasticized Tags:
 1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.
- F. Self-Adhesive Plastic Signs:
 1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
 2. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.
- G. Baked Enamel Danger Signs:
 1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

H. Engraved Plastic-Laminate Signs:

1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
2. Thickness: 1/8", except as otherwise indicated.
3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3- EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC and OSHA.
2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Box Identification:

1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits and a red marker for emergency circuits.

C. Underground Conduit Identification:

1. During back-filling/top-soiling of each exterior underground electrical, signal or communication conduit, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
2. Install line marker for every buried conduit, regardless of whether direct-buried or protected in conduit.

D. Cable/Conductor Identification:

1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with

marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work. Refer to WIRES AND CABLES section of these specifications for color coding requirements.

E. Operational Identification and Warnings:

1. Wherever required by OSHA or directed by the Owner, to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

F. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work or the Owner as constituting similar dangers for persons in or about project.
 - a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
 - b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.
2. Provide DANGER signs on covers of all panels, switchboard and motor control centers.

G. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/-control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
 - a. Panelboards, electrical cabinets and enclosures.
 - b. Access panel/doors to electrical facilities.
 - c. Major electrical switchgear.
 - d. Motor control centers.
 - e. Transformers.
 - f. Power generating units.
 - g. Automatic transfer switch.
2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.

3. Panelboards, individually mounted circuit breakers, and each feeder breaker in the distribution panels shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum 1/4" high letters.
 - a. 480/277 volt normal power equipment shall be identified with white faceplate with black core.
 - b. 480/277 volt emergency power equipment shall be identified with white faceplate with red core.
 - c. 208/120 volt essential power equipment shall be identified with red faceplate with white core.
 - d. Equipment identification is to indicate the following:
 - 1) Equipment ID abbreviation.
 - 2) Voltage, phase, wires and frequency.
 - 3) Emergency or other system.
 - 4) Power source origination. Example:
 - a) Panel E3HA
 - b) 480/277V, 3 phase, 4 wire
 - c) Emergency System
 - d) Fed by SWBD-7

END OF SECTION 26 05 53

SECTION 26 22 00 – TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of the furnishing, connection and installation of dry type transformers.
- B. Definition: Dry type transformers, as described herein, applies to those with primary and secondary voltage connections of 600 volts and less. Autotransformers are not acceptable, except where indicated for buck boost or zig-zag connections.

1.03 QUALITY ASSURANCE

- A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.
 - 1. Underwriter's Laboratories, Inc. (UL) Publications:
 - a. No. 506 Transformers (1000 KVA, 3 phase and below; 167 KVA, 1 phase and below)
 - 2. National Fire Protection Association (NFPA):
 - a. No. 70 National Electrical Code (NEC)
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. No. ST-20 Dry-type transformers for general applications
 - 4. American National Standards Institute (ANSI):
 - a. No. C57.12.80 Terminology for Power and Distribution Transformers
 - b. No. C57.12.90 Guide for Short Circuit Testing of Distribution and Power Transformers
 - c. No. C57.94 Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
- B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
 - 1. Eaton
 - 2. Siemens
 - 3. Square D
- C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure transformer access and clearance minimums are provided, and adequate ventilation is permitted.

1.04 SUBMITTALS

- A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Manufacturers Product Data:

1. Submit material specifications and installation data for products specified under PART 2 - PRODUCTS. Product data shall indicate sound and temperature rating, overload capacity and efficiency at 25%, 50% and 100% load, available taps, voltage, impedance, nameplate data, wiring diagrams, physical dimensions and net weight. Product data shall also contain certification that transformers are constructed and tested in accordance with standards specified herein.

C. Record Drawings. Include in each set:

1. A complete set of manufacturers product data indicating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Furnish all materials specified herein and indicated on the drawings.
- B. All transformers shall be UL listed and bear a UL label.
- C. Transformers shall be self-cooled, rated for continuous operation at rated KVA, 24 hours per day, 365 days per year with normal life expectancy (IEEE Standard No. 65). KVA ratings shall be as indicated on the drawings.

2.02 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Insulation System

1. Single phase 25 - 167 KVA and three phase 30 - 1500 KVA: Transformers shall be rated for average temperature rise by resistance of 150°C. in 40°C. maximum ambient, 30°C average ambient. Transformer insulation system shall be UL rated as 220°C. system.
2. Three phase 3 - 15 KVA: Transformers shall be rated for average temperature rise by resistance of 115°C. Insulation system shall be 180°C.
3. Single phase up through 250 VA: Transformers shall be rated for 55°C. rise by resistance. Insulation system shall be 105°C.
4. Single phase 500 - 3000 VA: Transformers shall be rated for 115°C. temperature rise by resistance. Insulation system shall be 180°C.

- B. Sound rating shall not exceed NEMA and ANSI standards for KVA rating. Internal vibration dampening shall be provided as a standard feature of all transformers.

- C. Single phase transformers rated up to 15 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All other single phase and all three phase transformers shall be provided with six 2-1/2% full capacity taps, two above and four below normal voltage unless only four 2-1/2% taps, two above and two below normal voltage, are standard.

- D. Construction and Enclosures

1. Transformers 30 - 1500 KVA: Transformer enclosures shall be open, ventilated, drip-proof with removable front and rear cover panels. Transformers shall be suitable for floor mounting, unless wall mounting is indicated on the drawings.
 2. Transformers up through 25 KVA: Transformers shall be totally enclosed, non-ventilated with a resin encapsulated core and coil and drip-proof housing. Removable panel section shall permit access to wiring compartment.
- E. Dry type transformers shall provide 3 phase 4 wire 208Y/120 or 1 phase 3 wire 230/115 volt service, as indicated on the drawings, to designated panelboards or other equipment. Primary rating shall be 480 volts.
- F. Nominal transformer impedance shall be 4.5 percent minimum, unless otherwise indicated on the drawings.
- G. Dry type transformer K-factors shall be as indicated on the drawings and as outlined in ANSI C57.110 "Recommended Practice for Establishing Transformer Capability when Supplying Nonsinusoidal Load Currents."
- H. Core assemblies and the center ground connection point of the coil secondaries shall be grounded to their enclosures by adequate, flexible ground straps. Provide grounding lug at the strap to enclosure bonding location for connection of three conductors; the primary and secondary equipment grounding conductors and the grounding electrode conductor.
- I. Provide weather shield on transformers indicated on drawings and for all exterior installations.

PART 3- EXECUTION

3.01 INSTALLATION

- A. Dry transformers larger than 15 KVA shall be floor mounted, unless wall or suspension mounting is indicated on the drawings. Transformers 15 KVA and smaller shall be wall mounted. Installation shall provide not less than twelve inch clearance from walls or equipment. Floor mounted transformers shall be mounted on neoprene, waffle type vibration pads 5/8" thick. Where transformers are indicated on the drawings, or specified herein to be mounted on suspended channels of angles or wall mounted, transformers shall be bolted to structure with 5/8" thick vibration pad between transformer base and structural surface. Loosen shipping bolts to free up internal vibration mounts on core and coil assembly.
- B. Primary and secondary connections to dry type transformers shall be made with flexible conduit.
- C. The secondary windings of each dry type transformer shall be grounded in accordance with the National Electrical Code requirements for separately derived electrical systems. Extend a grounding electrode conductor from the transformer grounding lug to the nearest building structural steel or main column rebar. Connect the primary and secondary feeder equipment grounding conductors to the grounding lug. Refer to the secondary grounding section of these specifications for additional requirements.
- D. Install secondary overcurrent protective device within 10 feet of conductor length. Where none is indicated on plans, provide enclosed circuit breaker within 10 feet rated at 125

percent of the transformer full load ampacity but not greater than the secondary conductor ampacity.

- E. Do not install equipment over transformer, unless indicated on the drawings.
- F. Locate transformers to provide working clearance and full accessibility as required by the National Electrical Code.

3.02 CLEANING AND ADJUSTMENT

- A. Prior to final inspection, under maximum available load, measure secondary voltage and adjust tap setting to deliver nominal rated voltage within the percentage limits of one tap setting. Record the voltages of each transformer and submit in accordance with the requirements specified in the basic electrical requirements section.
- B. After completion, clean the interior and exterior of dirt, paint and construction debris.
- C. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 IDENTIFICATION

- A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

- A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

END OF SECTION 26 22 00

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of the furnishing, installation and connection of lighting and appliance panelboards and distribution type panelboards.
- B. Panelboards designated as HDA, HDB, DA, DB, etc., or indicated on the drawings shall be distribution type panelboards. Those designated as HA, HB, A, B, etc., are lighting and appliance type panelboards.
- C. Definitions: The term panelboard, as used in this specification or on the drawings, shall mean the complete assembly including the enclosure, bus work, trim hardware and circuit breaker or fused devices. The words panel and panelboard are used synonymously in these contract documents.

1.03 QUALITY ASSURANCE

- A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 50: Cabinets and Boxes, Electrical
 - b. No. 67: Panelboards
 - c. No. 489: Molded Case Circuit Breakers and Circuit Breaker Enclosure
 - 2. National Electrical Manufacturer's Association (NEMA) Publications:
 - a. No. PB-1: Panelboards
 - b. No. AB-3: Molded Case Circuit Breakers
 - 3. National Fire Protection Association (NFPA):
 - a. No. 70: National Electrical Code (NEC)
- B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
 - 1. Siemens
 - 2. Eaton
 - 3. Square D
- C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure panel access and insure that clearance minimums are provided.

1.04 SUBMITTALS

- A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

- B. Manufacturers Product Data:
 - 1. Submit material specifications and installation data for products specified under Part 2 - Products to include:
 - a. Circuit breakers
 - b. Panelboards
- C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.
 - 1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
 - 2. Include front elevation bussing diagram indicating each bussing circuit breaker position.
 - 3. Provide a schedule indicating circuit breaker type, trip and size, poles, frame type, and interrupting capacity.
- D. Record Drawings. Include in each set:
 - 1. A complete set of panelboard manufacturers product data and shop drawings indicating all post bid revisions and field changes.
 - 2. A copy of each panelboard directory incorporating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

- A. Furnish all materials specified herein.
- B. All panels and circuit breakers shall be UL listed and bear a UL label.
- C. Panels shall be of the dead front safety type.
- D. Provide panels complete with factory assembled circuit breakers connected to the bus bars in the positions shown on the panel schedules or bus diagrams as indicated on the drawings.
- E. Number all panelboard circuits in the following sequence:
 - 1. Circuits No. 1 and 2, Phase A; Circuits No. 3 and 4, Phase B; Circuits No. 5 and 6, Phase C. Connect two pole breakers to phase indicated on the drawings.

2.02 BUSSING AND INTERIORS

- A. All bus bars shall be copper. Main lugs and main breakers shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain an equipment grounding bus. Each lighting and appliance panelboard shall contain a full size insulated neutral bus. Where a distribution type panelboard is indicated on the drawings to have a neutral bus, the bus shall be insulated and full size, unless otherwise indicated on the drawings.
- B. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

- C. The ground bus shall be factory brazed, riveted or installed on studs bolted to the panel enclosure or panel frame. The ground bus shall not be attached to the panel interior.
- D. Where designated on panel schedule as "space", include all necessary bussing, device support and connections. Provide blank cover for each space.

2.03 ENCLOSURES

- A. Panelboard width shall not be less than 20", nor more than 22" unless specific width is indicated on the drawings. Panelboard depth shall not exceed 5-3/4".
- B. Distribution panelboard width shall not be less than 31" and the depth shall not exceed 14".
- C. Review panelboard schedules and system one line diagram and provide panelboard gutters and bending space at terminals to conform to the National Electrical Code.
- D. Provide concealed captive clamping devices, concealed hinges and lock for all flush mounted panels. Key all panels throughout project alike.
- E. All surface mounted panels, except exterior rated panels, shall be provided with door-in-door hinged cover trims. Trims shall be secured by piano hinges to enclosure and secured closed by two trim clamps.
- F. Provide a directory card, metal holder, and transparent cover permanently mounted on inside of doors.
- G. Where indicated on the drawings or required for the environmental conditions, provide a NEMA 4X enclosure.
- H. Provide mini-power center panels with integral main breaker, dry type transformer and panel where indicated on the drawings.

2.04 CIRCUIT BREAKERS

- A. Interrupting rating of all circuit breakers in panelboards operating on 208Y/120 volt system shall have UL rating of not less than 10,000 RMS symmetrical amps at system voltage. Panelboards for use on 480Y/277 volt system shall contain circuit breakers with UL interrupting rating of not less than 14,000 RMS symmetrical amps at system voltage. Provide circuit breakers with higher interrupting capacity when indicated on the drawings.
- B. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the drawings or specified herein.
- C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.
- D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panelboards shall be bolted to the bus except, Square D I-line style plug in devices are acceptable.

- E. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less. Magnetic trip shall be adjustable for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.
- F. Provide the following special devices and accessories when indicated on the drawings, specified herein, or required by the NEC.
 - 1. Ground fault interrupting circuit breaker (GFI).
 - 2. Provide handle lock-off device to prevent manually turning off device without removal. Install on all circuit breakers indicated on the panel schedule.

2.05 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

- A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

PART 3- EXECUTION

3.01 INSTALLATION

- A. Mount panelboards with top circuit not more than 6'-6" above finished floor.
- B. Lace and group conductors installed in panels with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug.
- C. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the specifications and do not exceed.
- D. Mounting and Support
 - 1. Mounting
 - a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
 - b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
 - c. Attach enclosure directly to masonry, concrete, or wood surfaces.
 - d. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure or sheet rock walls.
- E. Conductors not terminating in panelboard shall not extend through or enter panel enclosure.
- F. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.
- G. Provide in each panelboard with a typewritten circuit directory mounted under clear plastic in a metal directory frame on interior of panel door. Directory shall reflect any field changes or additions.

H. Install push-in knock-out closure plugs in any unused knock-out openings.

I. Identification

1. Panelboards and individually mounted circuit breakers shall be identified.
2. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.
3. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

3.02 CLEANING AND ADJUSTMENT

- A. After completion, clean the interior and exterior of dirt, paint and construction debris.
- B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.
- C. Adjust and align panelboard interior and trim in accordance with manufacturers recommendations, and to eliminate gaps between the two.

3.03 FIELD QUALITY CONTROL

- A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.
- B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

END OF SECTION 26 24 16

SECTION 26 24 19 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.02 SUMMARY

- A. The work required under this section of the Specifications consists of the installation of modifications and additions to existing motor control center. All work shall match and be compatible with the existing MCC. Make all modifications required. All materials and devices which are an integral part of the Motor Control Center shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

- A. Coordination
 - 1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

- A. Refer to basic electrical requirements section for submittal requirements.
- B. Manufacturer's Product Data:
 - 1. Submit material specifications and installation data for products specified under Part 2 - Products to include:
 - a. Motor controllers
- C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.
 - 1. Provide a schedule indicating motor control unit type, or trip and size, poles, frame type, fuse size and type, and interrupting capacity.
 - 2. Identification designation schedule.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish all materials specified herein.
- B. Motor control units, circuit breakers, and fused devices shall be UL listed and bear the UL label.
- C. The motor control center shall be suitable for operation on a 480 3-phase, 3-wire 60 Hz system.
- D. Motor control center wiring shall be NEMA Class I type B.

2.02 UNIT CONSTRUCTION

- A. Combination magnetic starters shall be installed in removable units constructed in basic heights of 12" or multiples thereof. Each unit shall be isolated from others on structure. Connection to vertical bus for NEMA size five across the line starters and smaller shall be made with draw out stab type connection. Each plug-in type unit shall have a provision for positive horizontal and vertical alignment. Provisions shall also be included for positive ground connections through plug-in facilities. Each magnetic starter shall contain an overload relay in each phase, three in all. Each unit shall contain separable control terminal blocks and separable power terminal blocks to permit removal of unit without disturbing control wiring.
- B. Magnetic starters shall be the combination type with molded case circuit breakers. UL listed interrupting rating of molded case circuit breaker shall not be less than indicated on the drawings at system voltage.
- C. Provide reduced voltage solid state starters where shown. Each starter to have ramp up and ramp down adjustable controls. Coordinate rating of RVSS with motor provided. Provide HOA switch, red 'RUN' pilot lamp, blue 'OVERLOAD' pilot lamp and 2 NO/NC contacts.
- D. Individual starter doors and individual overcurrent device doors shall be interlocked to prevent door from being opened until switch is in "OFF" position. However, a "cheater screw" or other inconspicuous means shall be provided to permit access to energized starter, by authorized personnel. An interlock contact shall be provided within the starter to open control circuit to magnetic starter when device handle is in the open position. A door activated interlock switch is not acceptable.
- E. Each magnetic starter shall be provided with HOA switch, as indicated on the drawings. Where no device is indicated on the drawings, provide an HOA switch for any motors automatically controlled or an ON-OFF switch for those specified to be manually controlled. Provide each magnetic starter with a "RUN" and an "OVERLOAD" pilot lamp. Control devices shall be of oil tight construction and shall be mounted on a removable panel on the unit door. Identify each control device with a metal tag or plastic laminated label.
- F. Overload heaters shall be electronic adjustable type shall be selected in accordance with full load rating of motors actually furnished. Relay switching mechanism shall be single pole, double throw with normally open position connected to operate a door mounted, oil tight blue pilot lamp to indicate starter has tripped on overload.

- G. Control voltage for magnetic starters shall be 120 volts obtained from a individual control power transformers in each magnetic starter. Each control power transformer shall be fused.
- H. Provide contacts in magnetic starters to provide interlocking control sequence of operation. Provide two normally open and one normally closed spare auxiliary contacts in each starter.
- I. Starter sizes are based on design conditions using horsepower ratings of motors indicated on drawings. If motors actually furnished have horsepower ratings other than those indicated, motor starters and feeders shall be adjusted in accordance with the rated horsepower at no additional cost to the Owner.
- J. Provide, where indicated, molded case circuit breakers for feeder protection. All circuit breakers shall have UL interrupting rating of not less indicated on the drawings, at system voltage. Provide current limiting breakers as required.

2.03 AUXILIARY EQUIPMENT

- A. Identification:
 - 1. The motor control center, each magnetic starter, each feeder protective device, and each auxiliary equipment item shall be provided with an engraved plastic nameplate approximately 1" x 3" permanently attached to the unit exterior door with self-tapping screws. Refer to ELECTRICAL IDENTIFICATION section.
 - 2. Refer to the basic electrical requirements section of these specifications for nameplate requirements.
 - 3. Submit complete schedule with the shop drawings listing all nameplates and information thereon.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Control and power circuits shall terminate in respective section in which starter is located.
- B. Lace and group conductors installed in motor control center with nylon tie straps. Only one conductor shall be installed under each terminal. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eighth inch from terminal lug.
- C. Do not splice conductors in motor control center. Where required, installed junction box adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the wires and cables section section of the specifications and do not exceed.
- D. Conductors not terminating in motor control center section or unit shall not extend through or enter the section or unit.
- E. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.

3.02 CLEANING AND ADJUSTMENT

- A. After completion, clean the interior and exterior of dirt, paint and construction debris.
- B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.
- C. Select and install overload heaters based on the full load current of the motor actually installed. All heaters in a starter shall be of the same size.

3.03 IDENTIFICATION

- A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

- A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.
- B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

END OF SECTION 26 24 19

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work included under this section of the specifications consists of the installation of wiring devices, i.e. switches and receptacles and device plates. All materials shall be provided under this section of the specifications.
- B. Select devices from lists of acceptable devices contained in this section of the specifications.
- C. The catalog numbers listed herein for switches and receptacles are for items with brown finish. Notwithstanding catalog numbers, the switches and receptacles provided on this project shall have ivory finish unless otherwise indicated. All special purpose receptacles shall be provided in black finish.

1.03 QUALITY ASSURANCE

- A. NEMA WD-1 General Purpose Wiring
- B. NEMA WD-5 Specific Purpose Wiring Devices

PART 2 - PRODUCTS

2.01 SWITCHES

- A. Select switches from the following:
 - 1. Single pole, 20 amp 277 volt switch: Arrow Hart 1991, Hubbell 1221, Leviton 53521, Pass & Seymour 20AC1.
 - 2. Threeway, 20 amp 277 volt switch: Arrow Hart 1993, Hubbell 1223, Leviton 53523, Pass & Seymour 20AC3.
 - 3. Four way, 20 amp 277 volt switch: Arrow Hart 1994, Hubbell 1224, Leviton 53524, Pass & Seymour 20AC4.
 - 4. Weatherproof, 20 amp 277 volt switch: Arrow Hart 2991-2881G, Hubbell 1281-1750, Pass & Seymour 22515-4515.

2.02 RECEPTACLES

- A. Select receptacles from those listed herein. Designation in parenthesis is NEMA configuration required.
 - 1. 15 amp, 125 volt grounded duplex receptacle (5-15R): Arrow Hart 5262, Hubbell 5262, Leviton 5262, Pass & Seymour 5262.
 - 2. 20 amp, 125 volt grounded duplex receptacle (5-20R): Arrow Hart 5739, Hubbell 5362, Leviton 5362.

3. Ground Fault Interrupter (GFI) 15 amp, 125 volt duplex receptacle: Leviton 6194, Arrow Hart 1591, Hubbell GFTWRST82, Pass & Seymour 1591-F.
4. Ground Fault Interrupter (GFI), 15 amp 125 volt duplex receptacle, through feed type: Arrow Hart 1591-F, Leviton 6399, Pass & Seymour 1591-F, Hubbell GFTWRST83.
5. Transient Voltage Surge Suppression (TVSS) receptacles shall comply with ANSI/IEEE C62.41 and LIL449 (July 1987) for categories A and B. Devices shall provide RFI and EMI noise filtration of not less than a 7:1 reduction. Devices shall suppress transients in each of 3 modes: Line-to-neutral, line-to-ground, and neutral-to-ground. Devices shall be provided with an LED for positive indication of failure of protective circuitry or audible alarm. Products complying with this specification manufactured by Arrow Hart, Hubbell, Leviton, or Pass and Seymour are acceptable.

2.03 DEVICE PLATES

- A. Device plates shall be one piece single or multi-gang type selected to match the device or combination of devices. Device plates for flush mounted devices shall be type 302 stainless steel unless indicated otherwise.
 1. Device plates for use with devices flush mounted in exposed masonry construction shall be jumbo type. Device plates for surface mounted devices shall be for use with the type of outlet box in which the device is mounted. All devices installed in areas exposed to the weather and where indicated on the drawings shall be provided with a weatherproof device plate.
 2. Where engraved device plates are indicated on the drawings or specified in Division 16, engraving shall be done by the device plate manufacturer. All lettering shall be 1/8" high and shall be black unless other contrasting color is specified.

PART 3- EXECUTION

3.01 GENERAL INSTALLATION

- A. The mounting height of devices are indicated in the legend on the drawings and is intended to mean the bottom of the device above the finished floor unless otherwise indicated on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.
- B. Review Engineering Drawings for any device requiring specific location. Install receptacles above countertops with major axis horizontal above the backsplash.
- C. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominate building feature, i.e., doorframes or countertops.
- D. Install wall switches on the strike side of doors.

END OF SECTION 26 27 26

SECTION 26 28 16 – CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section covers disconnect switches for electrical equipment, 600V and below, and fuses mounted in the disconnect devices.
- B. Furnish and install disconnect switches for any of the following conditions:
 - 1. Where indicated on the drawings.
 - 2. For all motors located out-of-sight of its motor controller.
 - 3. For water heaters.
 - 4. For electrical unit heaters.
 - 5. Where required by the National Electrical Code.

1.03 QUALITY ASSURANCE

- A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.
 - 1. Underwriters' Laboratories, Inc. (UL) Publications:
 - a. No. 98: Enclosed Switches
 - b. No. 198.2: High-Interrupting Capacity Fuses, Current Limiting Type
 - c. No. 198.4: Class R fuses
 - 2. National Fire Protection Association (NFPA) Publications:
 - a. No. 70: National Electrical Code (NEC)
 - 3. National Electrical Manufacturers Association (NEMA) Publications:
 - a. No. KS 1: Enclosed Switches
- B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
 - 1. Siemens
 - 2. Eaton
 - 3. Square D
- C. Coordination: Coordinate installations with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure disconnect switch access and insure that clearance minimums are provided.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

- A. Furnish all materials specified herein.
- B. All disconnects and fuses shall be UL listed and bear a UL label.

- C. Fuses shall be heavy duty, type HD horsepower rated as required for motor load served.
- D. Switches shall be 600 volt rated, except for use in system below 240 volt, when they may be 250 volt rated. Switches shall be heavy duty rated. General duty switches are not acceptable.
- E. Furnish a solid neutral for each switch being installed in a circuit which includes a neutral conductor.
- F. Furnish an equipment grounding conductor lug bonded to the switch enclosure.
- G. Disconnect switches shall be non-fusible safety switch, unless fused type is specified or indicated on the drawings, with the number of poles required to disconnect all ungrounded conductors serving equipment.
- H. Enclosure shall be NEMA Type One in all interior dry locations and shall be NEMA Type 4X stainless steel in all damp, wet, or exterior locations, unless other type is indicated on the drawings or specified herein.

2.02 PRODUCT/MATERIAL DESCRIPTION

- A. Switching mechanism shall be quick-make, quick-break type.
- B. Where non-fused disconnect switches are indicated on the drawings or specified for use as disconnects, they shall be the non-fused type.
- C. Switches shall have the following features:
 - 1. Provide line terminal shields in all switches.
 - 2. Each switch shall have provisions for padlocking in the "OFF" position.
 - 3. Each switch shall have door interlocks to prevent door from being opened when switch is in closed position. Provide inconspicuous means to defeat interlock mechanism.
 - 4. Provide permanent nameplate indicating switch rating in voltage, amperes and horsepower.
 - 5. Arch chute for each pole.
 - 6. Provide auxillary contacts (break-first/make-last) for VFD driven motors.
- D. Disconnect switches for three phase motors rated two horsepower and above shall be three pole nonfusible type rated as indicated on the drawings. Disconnect switches for three phase motors rated below two horsepower shall be three pole manual motor starter switches without overload protection. Disconnect for single phase motors shall be single or two pole horsepower rated switches without overload protection.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate disconnect switches to maintain line of sight and to provide working clearance and full accessibility as required by the National Electrical Code.
- B. Unless indicated otherwise on the drawings, locate disconnects adjacent to equipment served.

- C. Lace and group conductors installed in disconnect with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond 1/8" from terminal lug.
- D. Mounting and Support
 - 1. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
 - 2. Mounting
 - a. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
 - b. Attach enclosure directly to masonry, concrete, or wood surfaces.
 - c. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure, sheet metal equipment enclosure, or sheet rock walls.
 - d. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure. Refer to the detail on the drawing for frame installation and construction information.
 - e. Mount switch with handle between 36" and 60" above floor or grade, unless otherwise indicated on the drawings.
- E. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to disconnect and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.
- F. Conductors not terminating in disconnect shall not extend through or enter disconnect enclosure.
- G. Install push-in knock-out closure plugs in any unused knock-out openings (NEMA1). Provide Hoffman Hole-Seal in NEMA 4X switches.
- H. Identification
 - 1. Disconnect switches shall be identified.
 - 2. Refer to the ELECTRICAL IDENTIFICATION section of the specifications for identification requirements.

3.02 CLEANING AND ADJUSTMENT

- A. After completion, clean the interior and exterior of dirt, paint and construction debris.
- B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF SECTION 26 28 16

SECTION 26 29 13 – MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of the installation of motor controllers for all integral or fractional horsepower motors not controlled by magnetic starters installed in motor control center or by magnetic starters provided as an integral component of a specific piece of equipment. Provide all material under this section of the specifications.

1.03 QUALITY ASSURANCE

- A. ANSI/NEMA Standards Publication ICS 1 - General Standards for Industrial Control and Systems.
- B. ANSI/NEMA Standards Publication ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
- C. UL 508 Standards for Industrial Control Devices, Controllers and Assemblies - Industrial Control Equipment.

1.04 ACCEPTABLE MANUFACTURERS

- A. The products of Siemens, Square D, or Eaton conforming to these specifications are acceptable.

PART 2- PRODUCTS

2.01 MAGNETIC STARTERS

- A. Magnetic starters shall be across-the-line circuit breaker combination type non-fusible disconnect combination type when remotely located from circuit breaker in panel or switchboard; otherwise magnetic starters shall be non-combination type. Where circuit breaker type are used, UL interrupting rating of circuit breaker shall not be less than the rating of the overcurrent device immediately upstream.
- B. Magnetic starters shall be NEMA size one unless other size is shown on the drawings or unless larger size is required by actual motor controlled. Enclosures shall be NEMA one unless otherwise shown on the drawings or specified in this section of the specifications. Starters shall be for operation at the voltage and phase arrangement indicated.

- C. Each magnetic starter shall have solid state overload protection for each phase leg. Control voltage shall be 120 volts provided from a control power transformer built into starter. Provide fuse for control coil. Provide Hand-Off-Automatic switch, in cover of starter unless otherwise indicated on the drawings. Interlocks shall be provided to provide control sequence indicated on the drawings. Interlock contact shall be provided circuit breaker of combination magnetic starters to disconnect control circuit when circuit breaker is in "off" position.
- D. Operating handle of disconnect device in combination starters shall be interlocked with door to prevent opening door when starter is energized; however an inconspicuous means shall be provided to defeat this interlock. Operating handle must have provisions for not less than two padlocks.
- E. Overload relay shall be solid state type and shall be selected from actual nameplate rating of motor furnished.

2.02 MANUAL MOTOR STARTERS

- A. Manual motor starter shall be manually operated, trip free switching device with motor running protection overload elements in each ungrounded conductor of the motor circuit. Overload protection shall be melting alloy or bi-metallic manual reset type.
- B. Manual starters installed in finished spaces shall be provided in flush mounted enclosures. Those exposed to the weather shall be provided with NEMA 4X enclosure. All other enclosures shall be NEMA one type.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Secure wall mounted magnetic starters to mounting surface with wood screws on wood, toggle bolts on hollow masonry, and lead shields on solid masonry.
- B. Manual motor starters shall be provided for all fractional horsepower, single phase motors rated 1/6 HP or larger.
- C. Overload element shall be selected in accordance with full load nameplate rating of motor actually served. A heater schedule shall be provided on inside cover all motor starters.

3.02 IDENTIFICATION

- A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.03 FIELD QUALITY CONTROL

- A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

END OF SECTION 26 29 13

SECTION 26 32 13 – ENGINE DRIVEN EMERGENCY POWER SUPPLY SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consists of the installation of the complete Engine Driven Emergency Power Supply System. All materials and devices which are an integral part of this system shall be provided under this section of the specifications.
- B. Definition: The Emergency Power Supply System (EPSS) shall consist of one or more engine driven generator sets, each of which contains an engine directly coupled to an electric generator, together with the necessary switchgear, controls, accessories, transfer devices, and fuel supply to provide electric power for the duration of any failure of the normal power supply.
 - 1. Automatic Transfer Switch (ATS): An automatic transfer switch is self-acting equipment for transferring one or more load conductor connections from one power source to another.
- C. For this project the contractor shall provide a 600 KW/750 KVA diesel engine-generator sets with permanent magnet excitation, a Level 2 sound-attenuated 150mph wind rated aluminum housing, 1,000 gallon capacity double wall sub-base tank for generator, a 1200A 4-pole open transition automatic transfer switch.

1.03 QUALITY ASSURANCE

- A. The following specifications and standards are incorporated into and become a part of this specification by reference.
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA-37 Combustion Engines
 - b. NFPA-70 National Electrical Code
 - c. NFPA-110 Emergency and Stand-By Power Systems
 - 2. Diesel Engine Manufacturers Association (DEMA) Standard: Standard Practices for low and medium speed stationary diesel and gas engines.
 - 3. Electrical Generating Systems Association (EGSA) Standards:
 - a. EGSA CEP2 Codes for Emergency Power by States and Major Cities
 - b. EGSA GTD3 Glossary of Standard Industry Terminology and Definitions
 - c. EGSA ECB1 Performance Standard for Engine Cranking Batteries
 - d. EGSA TSS1 Performance Standard for Transfer Switches for use with Engine Generator Sets
 - e. EGSA BCES1 Performance Standard for Battery Chargers
 - f. EGSA ICAE1 Performance Standard for Electric Generator Set Instrument Control and Auxiliary Equipment
 - 4. Institute of Electrical and Electronics Engineers (IEEE) Standards:
 - a. IEEE 446 IEEE Recommended Practices for Emergency and Standby

Power Systems

- b. IEEE 472 Voltage Surge Withstand Capabilities
- 5. National Electric Manufacturers Association (NEMA) Standards:
 - a. MG-1 Motors and Generators
 - b. ICS1-109 Test and Test Procedures for Automatic Transfer Switches
 - c. ICS2-447 A.C. Automatic Transfer Switch
- 6. Underwriters Laboratories Inc. (UL) Publications:
 - a. UL 1008 Automatic and Non-Automatic Transfer Switches
- 7. American National Standards Institute (ANSI):
 - a. C37.90a Voltage Surge Withstand Capability
- B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
 - 1. Engine Driven Generator Sets:
 - a. Cummins
 - b. Caterpillar
 - 2. Transfer Switches and Generator Switchgear:
 - a. Cummins
 - b. ASCO 7000 series
 - c. Zenith
 - 3. Sub-Base Fuel Tanks:
 - a. Pryco
 - b. Simplex
 - c. Generator manufacturer
- C. Equipment Dimensions:
 - 1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where equipment of acceptable manufacturers listed exceeds the maximum dimensions, products of such manufacturers shall not be acceptable.
- D. Coordination:
 - 1. Review shop drawings submitted under this and other sections, as well as other divisions, to insure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications, and electrical equipment to insure access and to insure clearance minimums are provided.

1.04 SUBMITTALS

- A. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.
- B. Manufacturer's Product Data:
 - 1. Submit material specifications and installations data for products specified under Part 2 - Products to include:
 - a. Engine driven generator set
 - b. Transfer switch
 - c. Sub-base fuel tank

- C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Submittals containing less than the information listed below will be rejected.
1. Shop drawings for the engine driven generator sets shall contain not less than the information listed as follows:
 - a. Certification that the engine driven generator set(s) furnished will serve electrical loads indicated including motor starting loads with type(s) of starting indicated. Submit generator loading program with actual load information with shop drawings.
 - b. Continuous and stand-by rating of engine driven generator set(s) including voltage and phase.
 - c. Frequency and voltage regulation with maximum instantaneous voltage dip and time of recovery to stable operation.
 - d. Output voltage adjustment range in percentage of rated plant voltage.
 - e. Alternator type and method of connection to prime mover.
 - f. Components contained in alternator instrument panel.
 - g. Rating of engine at operating speed, engine cycle and number of cylinders.
 - h. Type of engine lubrication system and verification of components specified.
 - i. Type of engine governor.
 - j. Components contained in engine instrument panel.
 - k. Fuel consumption at rated load.
 - l. Starting batteries including ampere hour rating.
 - m. Verification that all accessories specified are to be provided. This includes tank with capacity indicated, cold weather starting aid with rating and voltage indicated, exhaust system with muffler type indicated, and outdoor housing with verification of space available within housing for batteries.
 - n. Line and machinery constants of the generator furnished.
 2. Shop drawings for the transfer switch shall contain not less than the information listed as follows:
 - a. List of accessories contained in the control panel.
 - b. Withstand rating in RMS symmetrical amperes.
- D. Quality and Service:
1. All materials and parts of the EPSS shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's parts and labor warranty for a minimum of five years from date of Owner acceptance of the project on a new machine, a copy of which shall be included in the shop drawings submittal.
 2. Submittals will be accepted only on engine driven generator sets and transfer switches which can be properly maintained and serviced without requiring the Owner to stock spare parts or wait longer than twenty-four hours for service. Submittals shall include the nearest location of permanent parts outlet from which parts may be obtained and written assurance that trained service personnel will be available on twenty-four hour's notice. Units with service centers more than 100 miles from project site will not be accepted.
- E. Record Drawings
1. Include in each set three sets of operating, maintenance, and parts manuals covering all components for the EPSS. Each supplier shall provide instructions to the Owner in

operation and maintenance of his equipment, both in written form and with on-site personnel for a minimum of eight hours.

PART 2 - PRODUCTS

2.01 ENGINE DRIVEN EMERGENCY POWER SUPPLY (EPS)

A. Engine

1. The engine driven emergency power supply (EPS) shall be internal combustion diesel driven prime mover. The generator sets shall have the following characteristics:
 - a. 600 KW Capacity
 - b. 750 KVA Capacity
 - c. 480Y/277V
 - d. 60Hz
 - e. 0.8 Power Factor
 - f. 3 Phase
 - g. 4-Wire
2. Refer to drawings for loads which are to be powered from the emergency power system.
3. The rated net horsepower of the engine at the generator synchronous speed, with all accessories, shall not be less than that required to product the KW specified in paragraph 1 above. The horsepower rating shall take into account generator efficiency and all accessory losses such as fans, battery charger, etc. The generator set shall be capable of producing the specified KW (without overload) for the duration of the power outage, under the following ambient conditions:
 - a. Altitude: 50 feet above mean sea level.
 - b. Air temperature at engine intake: 104 degrees F.
 - c. Humidity Range: 5 - 95%.
4. Included with the shop drawing submittal shall be the manufacturer's estimate of supply fuel and oil consumption for the engine. The engine shall have an oil filter with replaceable elements, and a lube oil cooler.
5. The engine shall be equipped with a suitable governor (engine speed control) to maintain frequency within limit specified below by controlling engine and generator speed. Provide controls to allow generator speed to be adjusted for forced closed transition operation.
 - a. Type: Isochronos
 - b. Stability: 1/2% maximum steady state frequency variation at any constant load from no load to full load.
 - c. Regulation: 5% maximum frequency deviation between no-load steady state and full load steady state.
 - d. Transient: 2 seconds maximum recovery time for maximum motor start.
6. The engine shall be electric start, provided with a solenoid energized motor with either positive engagement or clutch drive to the engine.
7. The engine starting batteries shall be sealed lead-acid recombination type. Batteries shall be rack mounted inside the weatherproof plant housing to minimize the distance from the batteries to the starter. Provide battery straps and battery heaters.
8. A float type battery charger, compatible with the batteries selected, shall be furnished at the engine which shall maintain the starting batteries at full charge. The charging system shall permit charging from either the normal or the emergency power source. Provide battery straps and battery heater per NFPA110.

9. It shall have an equalize rate and a float rate charging system. An ammeter and voltmeter shall indicate the charge rate and the circuit shall be protected by either fuses or circuit breakers. The charger or charging circuit shall be so designed that it will not be damaged during the engine cranking cycle, for example, by a current limiting charger or a crank disconnect relay. It shall also be capable of recharging a discharged battery in 12 hours while carrying normal loads. The charger shall be equipped with alarm relays as required for remote annunciation equipment.
10. The engine shall be liquid cooled. The type of liquid cooling system shall be unit mounted radiator - consideration shall be given for air temperature rise across the engine in addition to ambient. Minimum capacity shall be rated for 104°F. minimum engine ambient temperature plus air temperature rise across the engine.
 - a. Provide an electric heater, thermostatically controlled, in the engine coolant system as a cold weather starting aid. Heater shall be for operation on 120 or 240 volt single phase A.C. and shall be permanently connected to a circuit from the generator panel. Heater shall maintain 70°F. to 90°F.
 - b. Provide isolation valves or quick connect couplings for jacket water heater.
11. Air Supply/Exhaust System
 - a. Cleaner: An air cleaner and silencer shall be furnished, located and mounted as recommended by the engine manufacturer.
 - b. Exhaust: An exhaust system of suitable size, configuration, and material in accordance with engine manufacturer's recommendations shall connect the exhaust outlet of the engine to a silencer. The type of silencer shall meet the requirements of engine manufacturers and shall be critical. The silencer shall be located inside of the outdoor enclosure.
 - c. The exhaust system including silencer shall be of such size that back pressure on the system will not exceed the back pressure permitted by the engine manufacturer's recommendation. A flexible connection shall be mounted at the engine exhaust outlet and the discharge end shall be protected against entry of precipitation. Provide vertical discharge with rain cap. Piping and silencer within reach of personnel or with 8'-0" of finished floor or grade shall be protected by screening and shall be insulated with two inches of calcium silicate insulation with aluminum jacket. All exhaust piping shall be gas tight.
12. The engine instrument panel shall be mounted at the engine and shall contain the following:
 - a. Oil pressure gauge to indicate lubricating oil pressure.
 - b. Temperature gauge to indicate cooling medium temperature.
 - c. Hour meter to indicate total actual running time.
 - d. Battery charging meter to indicate satisfactory performance of battery charging means.
 - e. Other instruments as recommended by the manufacturer for proper maintenance.
 - f. Manual stop/start controls: All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified.

B. Generator

1. The generator shall be an engine-driven single or two bearings type, synchronous, brushless, conforming to applicable standards. It shall be connected to the engine flywheel by means of a flexible type coupling for single bearing generators and elastic coupling for two bearing generators.

2. The generator shall be rated for 40°C. ambient. Class of insulation shall be NEMA Class F. The voltage regulation shall be plus or minus 2% from no load to full load with plus or minus 5% speed change and a 15°C. rise in ambient. The generator voltage dip from no load to full load shall not exceed 16%.
3. The generator shall be capable of sustaining at least 250% of rated current for at least ten (10) seconds under a three phase symmetrical short by inherent design or by the addition of an optional current boost system. A line sensing protection system shall be furnished which protects the generator from damage due to its own high current capability. This shall not trip within the ten seconds specified above to allow selective tripping of downstream fuses or circuit breakers under a fault condition.
4. Provide 120 volt condensation heater in generator windings.
5. The generator shall be the Permanent Magnet type generator.

C. Voltage Regulation

1. The generator shall be equipped with a volts-per-hertz type voltage regulator to maintain voltage within limits specified below:
 - a. Stability: 2% maximum voltage variation at any constant load from no load to full load.
 - b. Regulation: 4% maximum voltage deviation between no load steady state and full load steady state.
 - c. Transient: 20% voltage dip or overshoot on one-step application or removal of 0.8 power factor full load.

D. Start and Stop Controls

1. Automatic starting and stopping controls shall be furnished to start the engine automatically when the normal electrical power fails or falls below specific limits and to stop the engine automatically after the normal power supply resumes. The signal for starting or stopping the engine shall be sensed through an auxiliary contact in the automatic transfer switch. The controls shall be capable of operating at 50% of normal DC system supplied voltage.
2. The cranking cycle shall be initiated by manual start, loss of normal power at any transfer switch, clock exerciser, or the manually operated test switch at each ATS.
3. Crank control and the time delay relays shall provide a minimum of 4 crank attempts of at least 7 seconds each, separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at the completion of the starting program, the overcrank signal shall indicate. The engine starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset.
4. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" position that permits the engine to be started manually by the pushbutton on the control cabinet and run unloaded; an "automatic" position that readies the system for automatic start or stop on demand or the automatic load transfer switches or of the programmed exerciser.
5. A remote weatherproof manual stop station for generator similar to a break-glass station shall be provided and shall be tied into the engine controls to stop the engine when activated. Provide laminated plastic label with 1/4" minimum engraved letters to read "EMERGENCY GENERATOR SHUTDOWN". Background to be red and core to be white.

E. Instrumentation

1. Local and remote engine control and safety panel shall be provided for each generator, containing the following:
 - a. Automatic remote start capability.
 - b. "Manual-Off-Auto" switch.
 - c. Controls to shut down and lock out the prime mover under the following conditions: failure to start after specified cranking time, overspeed, low lubricating oil pressure, high engine temperature, or operation of remote manual stop station.
 - d. Battery powered individual alarm indication to annunciate visually at the control and safety panel the occurrence of any condition itemized below; contacts or circuits for a common audible alarm signaling locally the occurrence of any itemized conditions listed below. Test switch shall be provided to test the operation of all lamps.
 - 1) Indicator Function, Level 1 (At Battery Voltage):

	Local and Remote Control Panels Mounted Visual Indication	Shutdown of EPS	Audible
a) Overcrank	X	X	X
b) Low Water Temp. < 70°F (21°C)	X		X
c) High Engine Temp. Pre-alarm	X		X
d) High Engine Temp.	X	X	X
e) Low Lube Oil Pressure Pre-alarm	X		X
f) Low Lube Oil Pressure	X	X	X
g) Overspeed	X	X	X
h) Low Fuel Main Tank	X		X
i) EPS Supplying Load	X		
j) Control Switch Not In Auto Pos.	X		X
k) Battery Charger Malfunctioning	X		X
l) Low Voltage in Battery	X		X
m) Lamp Test	X		X
n) Contacts for Local & Remote			
o) Common Alarm	X		X
p) Audible Alarm Silencing Switch			
q) Fuel in Containment Basin	X		X
r) Remote Emergency Stop	X	X	X

- 2) Controls to shutdown the prime mover upon removal of initiating signal or manual emergency shutdown.

- 3) A.C. voltmeter with selector switch off position and positions for phase to phase and phase to neutral.
 - 4) A.C. ammeter with selector switch with positions for each phase.
 - 5) Frequency meter -- digital electronic type.
 - 6) Voltage adjusting rheostat to allow plus or minus 5% voltage adjustment.
 - 7) Manual reset circuit breaker.
 - 8) Water temperature gauge.
 - 9) Manual stop/start control.
 - 10) Elapsed time meter.
 - 11) Panel lights.
 - 12) Indicator lights for signals from engine instrument panel.
 - 13) Light to indicate switch has been left in the "off" position.
2. All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified. All instrumentation must be isolated from engine generator set vibration.
 3. Provide Modbus TCP/IP connection for generator to communicate with SCADA system. Coordinate all parameters required by owner.
- F. Enclosures and Connections:
1. All electrical enclosures, i.e, terminal cabinets, wireways, circuit breaker enclosures, etc., shall be of adequate size to provide minimum bending radius as required by the NEC for the size conductor actually terminated within or passing through the enclosure.
 2. All factory provided enclosures shall have gasketing and finish appropriate for the environment in which the unit is to be mounted. All wiring, wiring harness, etc., shall be protected from the elements, such as direct sunlight, moisture, etc. or shall be UL listed for direct exposure to the applicable elements. Include written documentation of the above with the shop drawing submittal.
- G. Provide flexible fuel connections at supply at return piping. Flexible hoses shall be steel reinforced type. Provide solenoid valve in series with gate valve in supply line. Solenoid valve shall be powered from generator batteries and shall be open only when generator is running.
- H. Provide service lights, switch and receptacle within the generator enclosure. Provide battery pack with two heads inside each enclosure.

2.02 TRANSFER SWITCH(ES)

- A. Transfer switch(es) shall be rated at not less than as indicated on the drawings at rated voltage. Transfer switch(es) shall be rated and marked for total system load.
- B. Transfer switch(es) serving three phase four wire loads shall be four pole. Provide open transition type. Provide timed intermediate position.
- C. Transfer switch(es) shall be the automatic type with power contact assemblies. Transfer switches shall be U.L. listed and labeled 1008.
- D. Transfer switch(es) shall be floor mounted in a NEMA 4X stainless steel enclosure. Enclosure shall have hinged door with three point latching and provisions for pad locking.

- E. Operation shall be inherently double-throw whereby all contacts move simultaneously. Electrical spacing shall be equal to or exceed those listed in Table 15.1 of UL-1008. Only those main contact structures specifically designed for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position. A manual operating handle shall be provided. All main contacts shall be silver alloy type protected by arc quenchers and, for switches rated 600 amps and larger, by arcing contacts. Operating transfer time shall be 1/15 second or less on switches rated below 600 amps.
- F. All switch and contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panel from the enclosure and without disconnecting power conductors or drive linkages. Control and sensing relays shall be continuous duty industrial type with minimum contact rating of ten amps.
- G. Transfer switch shall be rated to withstand in RMS symmetrical amperes not less than the available symmetrical RMS amperes when protected by the circuit protective device on the line side of the transfer switch. Withstand rating of switch shall be based on switch contacts not welding under fault conditions.
- H. Transfer switches shall be U.L. listed and labeled for service entrance. Transfer switches shall be furnished with an insulated neutral, bonding jumper and a ground bar bolted to the transfer switch enclosure.
- I. The control panel for each automatic transfer switch shall contain the following accessories and Features.
 - 1. ATS Control Panel
 - a. The automatic transfer switch(es) shall provide a control panel mounted into the front of the switch. This control panel shall display source condition information including:
 - b. AC voltage for each phase of normal and emergency source. All three phases shall be displayed on a single screen for viewing of voltage balance and on 4-wire systems, line to neutral voltage shall be displayed for each phase.
 - c. Frequency of each source.
 - d. Display source status including indication whether source is/is not connected.
 - e. Provide Modbus TCP/IP interconnection to plant SCADA system to allow SCADA system to monitor switch. Coordinate all points with owner.
 - 2. The ATS control panel shall allow the operator to make adjustments to and/or set nominal voltage and frequency of the ATS, frequency sensor operation set points, time clock functions, and load sequence functions. The operator may also enable/disable ATS functions, set up exercise and load test operation conditions, normal system time delays for transfer, time delay to start, stop, transfer and retransfer. These parameters may only be accessed following password input from the authorized operator.
 - 3. The display shall include real time clock data, including date, time (HH:MM:SS) and log total operating hours for the control system.
 - 4. The display shall include a service history for the ATS and a fault history on the ATS.
 - 5. Adjustable 0.5 to 6 second time delay on starting of EPS to override momentary power dips and interruptions of the normal services. Time delay shall be factory set at 1 second.
 - 6. Time delay on transfer to emergency adjustable from 0 to 60 seconds, factory set at 0 seconds.

7. Test switch on enclosure door to simulate failure of the normal power source. ATS shall transfer load to the EPS.
8. Push button to bypass time delay on re-transfer to normal.
9. Close differential voltage sensing shall be provided on all phases of the normal power supply. The pickup voltage shall be adjustable from 85% to 100% of nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and re-transfer to normal shall occur when normal source restores to 95% of nominals.
10. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Pickup frequency shall be adjustable from 90% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.
11. A time delay on re-transfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 25 minutes and factory set at 15 minutes.
12. An unloaded running time delay for emergency generator cool-down, factory set at 5 minutes.
13. Provide adjustable timed intermediate position in both directions when not in closed transition mode.
14. Pilot light for indicating switch in normal position (include fuses and auxiliary contact).
15. Pilot light for indicating switch in emergency position (include fuses and auxiliary contact).
16. An exerciser for exercising standby power plant on a weekly basis shall be provided in the transfer switch. Exerciser shall be set to exercise standby plant for one half hour per week under load. Time of plant exercise shall be set in field. Exerciser timer shall have reserve power back-up, either by battery or spring-wound clock, to ride through power outages to the switch.
17. Auxiliary contact (gold plated) which closes when normal source fails. (Closed after override delay of 0.5 to 6 seconds).
18. Auxiliary contact (gold plated) which opens when normal source fails. (Opens after override delay of 0.5 to 6 seconds).
19. Auxiliary contacts on same shaft as main contacts (closed on normal.)
20. Auxiliary contacts on same shaft as main contacts (closed on emergency).
21. Provide 'ready to transfer' signal in both directions.

2.03 FUEL SUPPLY

- A. A double wall 1,000 gallon fuel storage tank for each generator shall be located in the skids below the generator set, and shall be complete with all piping and fittings connected. No galvanized material shall be used in the tank or fueling system. The tanks shall be vented to atmosphere. A fuel level gauge shall be located as indicated on the drawings. The system shall be supplied to deliver an adequate amount of fuel to the engine from the storage tank. Pipe sizes shall be no smaller than the minimum recommended by the engine manufacturer to avoid fuel flow restriction. The engine supply and return line shall be equipped with a length of flexible fuel lines, unions, and gate valves. No copper lines are acceptable. Provide lockable fill, and all venting as required. The tank shall fit within space provided.

- B. Provide a work platform around the sides and controls end of the generator, extending a minimum of three (3) feet from the generator, but in no case shall the platform be narrower than the length of the service doors so that the generator remains fully accessible for servicing. The platform shall be provided with a handrail, four feet high. The platform deck shall be equal in elevation to the top of the fuel tank and shall be supported by the concrete pad of the generator. The platform shall be fabricated from welded aluminum tubing, the deck shall be heavy duty aluminum grating, the platform shall be provided with aluminum steps as required to access the working deck elevation. All bolts to be aluminum. All anchor bolts to be stainless steel.
- C. Provide a set of normally open contacts in fuel level indicating system of fuel tank. Interconnect with remote low fuel alarm specified earlier in this section.
- D. Provide 'Fuel in Containment' contact in basin and Leak Detection System.
- E. Provide fuel sensing system for each tank so that if fuel level is over 90% an audible and visual alarm shall alarm. Provide engraved sign reading "DISCONTINUE FILLING IF ALARM SOUNDS."
- F. Provide 750 gallons of fuel for each tank at start of load bank testing.

PART 3- EXECUTION

3.01 EPS INSTALLATION

- A. The plant shall be anchored to a concrete base. See structural for slab details. Refer to the detail on the plans
- B. Provide a laminated sign at the service entrance equipment indicating type and location of on-site emergency power sources.
- C. For exterior installations, the EPS shall be provided in outdoor, weatherproof housing with removable panels for access to equipment. The starting batteries shall be rack mounted within the housing.
- D. The enclosure shall be constructed of pre-painted aluminum, panels and posts shall be 0.125" thick (ASTM B209, 5052 H32). The housing shall be wind rated to 150 mph per ASCE 7-98 exposure D, category 1 importance factor. The enclosure shall be required to provide sound attenuation, level 2.
- E. Provide LED service lights and weather proof switch within the housing. Connect the light to the battery charger 120 volt circuit. Provide receptacle and battery powered emergency light.
- F. Extend 120 and/or 230 volt emergency power circuits for chargers and cold weather starting aids from the control panel wiring system.
- G. The foundation of the generator shall be such that the top of the fuel tank is above the 100 year flood elevation. Refer to the Civil drawings for existing elevation datum. The service platform shall also be supported by the generator foundation.

3.02 TRANSFER SWITCH INSTALLATION

- A. Locate transfer switch(es) to provide working clearance and full accessibility as required by the National Electrical Code.
- B. Lace and group conductors installed in transfer switch with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eighths inch from terminal lug. Conductors shall be installed such that no stresses are transferred to terminal lugs.
- C. Mounting and Support
 - 1. Mounting
 - a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices to floor.
 - b. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to transfer switch and splice or tap conductors in box.
 - c. Conductors not terminating in transfer switch shall not extend through or enter transfer switch enclosure.
 - d. Install push-in knock-out closure plugs in any unused knock-out openings.
 - e. Free standing transfer switch(es) shall be installed on a four inch high concrete pad, with horizontal base dimension exceeding base dimension of switch by three inches.
 - f. Cleaning and Adjustment
 - 1) After completion, clean the interior and exterior of dirt, paint and construction debris.
 - 2) Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 TESTING

- A. Submit verification letter to Engineer indicating successful completion of sequence of operations testing and certification that all functions are operational. Letter to request load testing approval and schedule of proposed test. Prior to load test, written approval must be provided by Engineer. Representatives of the generator and transfer switch shall be present. The local authority having jurisdiction shall be given advance notification of the time of the final test in order that he may witness the tests.
- B. A failure of any test or any component during a test will require a complete retest program at no additional cost to the Owner.
- C. Provide all fuel, lubricants, and other consumables for testing.
- D. An on-site acceptance test shall be conducted as a final approval test for all Emergency Power Supply Systems.
 - 1. The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.
 - 2. Test Results. The EPSS shall perform within the limits specified in the standard NFPA-110, Level 1.

3.04 O&M MANUALS

- A. At least three sets of an instruction manual(s) for all major components of the EPS shall be supplied by the Manufacturer(s) of the EPS and shall contain:
 - 1. A detailed explanation of the operation of the system.
 - 2. Instruction for routine maintenance.
 - 3. Detailed instructions for repair of the EPS and other major components of the EPS.
 - 4. Pictorial parts list and part numbers.
 - 5. Pictorial and schematic electrical drawings of wiring systems, including operation and safety devices, control panels, instrumentation and annunciators.

3.05 GA POWER DOCUMENTATION AND ACCESSORIES

- A. Contractor shall contact GA Power and provide all necessary information as required for new generator with open-transition transfer switch, ready for owner's signatures.

END OF SECTION 26 32 13

SECTION 26 65 00 – ELECTRICAL EQUIPMENT ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. The work required under this section of the specifications consist of the start-up testing and inspection of the electrical equipment designated within. All labor and testing equipment which is required shall be provided under this section of the specifications.

1.03 GENERAL

- A. The Contractor shall perform the tests as outlined below to insure system acceptance.
- B. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the licensed electrical contractor who performed the tests.
- C. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the Engineer at least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 1 of this specification.

1.04 QUALITY ASSURANCE

- A. The testing and inspection shall comply with all applicable sections of the following codes and standards:
 - 1. American National Standards Institute - ANSI
 - 2. American Society for Testing and Materials - ASTM
 - 3. Association of Edison Illuminating Companies - AEIC
 - 4. Institute of Electrical and Electronics Engineers - IEEE
 - 5. Insulated Power Cable Engineers Association - IPCEA
 - 6. International Electrical Testing Association - NETA Acceptance Testing Specifications
 - 7. National Electrical Code - NEC
 - 8. National Electrical Manufacturers Association - NEMA
 - 9. National Fire Protection Association - NFPA
 - 10. State and Local Codes and Ordinances
- B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

1.05 DIVISION OF RESPONSIBILITY

- A. The contractor shall perform all tests.

- B. The contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.
- C. The contractor shall notify the Engineer prior to commencement of any testing.
- D. Any system, material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.
- E. The electrical contractor shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

1.06 SAFETY AND PRECAUTIONS

- A. Safety practices shall comply with applicable state and local safety orders as well as with the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the National Fire Protection Association standard NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.
- B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he has determined that it is safe to do so.
- C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

1.07 REPORTS

- A. The test report shall include the following sections:
 - 1. Scope of testing
 - 2. Equipment tested
 - 3. Description of test
 - 4. Test results
 - 5. Conclusions and recommendations
 - 6. Appendix, including test forms
- B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the technician who tested the equipment and the date of the test completion.
- C. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

1.08 TEST EQUIPMENT

- A. All test equipment shall be in good mechanical and electrical condition.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART 3 - EXECUTION

3.01 EQUIPMENT TO BE TESTED

- A. The following equipment shall be tested in accordance with the scopes of work which follow.

- 1.Dry Type Transformers
- 2.Molded Case Circuit Breakers
- 3.Motor Controllers
- 4Automatic Transfer Switches
- 5.Emergency Power Supply-Engine Driven
- 6.Grounding System
- 7.Cables, Low Voltage, 600 Volts Maximum
- 8.Ground Fault Systems

3.02 DRY TYPE TRANSFORMERS

- A. Visual and Mechanical Inspection

1. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and/or brush major insulating surfaces.
2. Check primary, secondary, and ground connections.
3. Check tap connections and tap changer.
4. Inspect all bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect insulators, spacers, and windings.
6. Inspect for adequate electrical clearance.
7. Check base or support insulators, including vibration isolation supports.
8. Check accessory devices for condition and proper operation.
9. Verify that the transformers have been provided with adequate spacing for ventilation.

- B. Electrical Tests

1. Insulation Resistance Test: Megger transformer windings high to low and ground, low to high and ground, and high and low to ground.
2. Include measured secondary voltage (line-to-line and line-to-ground) for each transformer in the test report. Secondary voltage readings, at each transformer, phase to phase neutral, and phase load readings shall be recorded and tap positions of transformer taps noted. This test shall be conducted with a calibrated voltmeter.
3. Each ground rod installation shall be tested after all connections to ground rods are made before grounding conductor connection is made to the transformer. Ground rod installations shall be tested by "fall of potential" measuring method using ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested.
4. Placement of auxiliary electrodes shall be in accordance with operating instructions of test meter, but in no case shall auxiliary current electrodes be placed within 70' of the

grounding system being tested. Test data shall indicate placement of auxiliary electrodes with respect to systems being tested, date readings were taken and lowest resistance recorded.

3.03 MOLDED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection

1. Inspect cover and case, and check for broken or loose terminals.
2. Operate breaker to check operation.

B. Electrical Tests (400 ampere frame and larger)

1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
3. Test overcurrent trip device and calibrate. Where primary injection testing is specified, test each pole of the breaker individually. Data shall be compared with manufacturer's published data.
 - a. All trip units shall be tested by primary injection.
 - b. Static overcurrent trip devices shall be tested per manufacturer's instructions.
 - c. Test for minimum pick-up current.
 - d. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
 - e. Where short time delay characteristics are provided, test short time pick-up and delay.
 - f. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
 - g. Where ground fault protection is provided, test ground fault pick-up and delay.
 - h. Check reset characteristics of trip unit.
4. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm switches, and auxiliary switches.

3.04 MOTOR CONTROLLERS

A. Visual and Mechanical Inspection

1. Verify that the contractor has cleaned structure interiors and starter cells of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
3. Check mechanical operation of starters for freedom from binding.
4. Check motor circuit protector setting and overload relay size against contractor furnished list of motor nameplate full load current values.

B. Electrical Tests

1. Verify operation of each starter.
2. Contact Resistance Test. Ductor across main pole contacts of each breaker or switch with device closed and latched to check for good, low resistance contact.

3.05 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection

1. Verify that contractor has cleaned enclosure interiors and all components of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect all electrical and mechanical components for condition and any evidence of defect or failure.
3. Perform inspection checks on individual components as recommended by the manufacturer.
4. Inspect connections for looseness. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect for missing or loose hardware or accessories.
6. Check for proper mechanical operation and lubricate, as necessary.
7. Check transfer mechanism for alignment and friction-free operation. Lubricate, as necessary.
8. Check all connecting wiring for condition.

B. Electrical Tests

1. Use test switch, when available, to check the electrical operation of the transfer switch.
2. When a test switch is not available, a failure of the normal source power will be simulated by disconnecting a voltage sensing lead.
3. Test and adjust all sensing relays, and other devices specifically associated with the transfer switch.
4. Contact Resistance Test: Ductor across main pole contacts of power switching circuit breakers, switches or contactor contacts with device closed and latched to check for good, low resistance contact.
5. Demonstrate bypass operation.

3.06 EMERGENCY POWER SUPPLY-ENGINE DRIVEN

A. Visual and Mechanical Inspection

1. Verify that contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check output circuit breaker(s) bus connection.
4. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect for missing or loose hardware or accessories.
6. Inspect grounding system connections.
7. Operate key and door interlock devices to assure proper operation.
8. Inspect all associated systems and circuits for proper operation, including but not limited to the fuel supply system, jacket heater, battery charger, engine mounted control panel, remote monitoring and control panel, emergency cut-off, battery lighting system, exhaust system, radiator system, and ventilator system.
9. Inspect anchoring and vibration isolation systems.

B. Electrical Tests.

1. Insulation resistance test: Megger main poles of output circuit breaker(s) pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts of output circuit breaker(s) with breaker closed and latched to check for good, low resistance contact.
3. Follow completely the load testing procedures of the latest issue of NFPA-110 for EPS systems, including prior notification of the local inspection authority having

jurisdiction. Include all measured data and conditions in the final report. All non-compliance items shall be corrected by the contractor and retested until full compliance with NFPA-110 is achieved.

3.07 GROUNDING SYSTEM

A. Visual and Mechanical Inspection

1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes.
2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests (Small Systems)

1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.

C. Equipment Grounds

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Test Values

1. The main ground electrode system impedance-to-ground should be no greater than 25 ohms for commercial or industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.08 CABLES - LOW-VOLTAGE - 600V MAXIMUM

A. Visual and Mechanical Inspection

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests

1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
2. Perform continuity test to insure proper cable connection.

C. Test Values

1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

3.09 GROUND-FAULT SYSTEMS (NEC 230-95)

A. Visual and Mechanical Inspection

1. Inspect for physical damage and compliance with drawings and specifications.
2. Inspect neutral main bonding connection to assure:
 - a. Zero-sequence sensing system is grounded.
 - b. Ground-strap sensing systems are grounded through sensing device.
 - c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
 - d. Grounded conductor (neutral) is solidly grounded.
3. Inspect control power transformer to ensure adequate capacity for system.
4. Manually operate monitor panels (if present) for:
 - a. Trip test
 - b. No trip test
 - c. Nonautomatic reset
5. Record proper operation and test sequence.
6. Set pickup and time-delay settings in accordance with the settings provided by the coordination study.

B. Electrical Tests

1. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.
2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.
3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameters

1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.
2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
3. Relay pickup value shall be within +/- 10% of setting and in no case greater than 1200A.

END OF SECTION 26 65 00

SECTION 28 31 11.01 - FIRE ALARM SYSTEM

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. The work required under this section of the specifications consists of the furnishing, installation and connection of the Fire Alarm System.
- B. Definition: The Fire Alarm System consists of an addressable control panel with alarm initiating devices for elevator installation as indicated on the plans.

1.3 QUALITY ASSURANCE

- A. Industry Referenced Standards: The following specifications and standards are incorporated into and become a part of the specification by reference.
 - 1. Underwriter's Laboratories, Inc. (UL) Publications:
 - a. No. 38: Manually actuated signaling box for use with Fire Protective Signaling Systems.
 - 2. National Electrical Manufacturer's Association (NEMA) Publications:
 - a. No. SB3: Interconnection Circuitry of Non-Coded Remote-Station Protective Signaling Systems.
 - 3. National Fire Protection Association (NFPA):
 - a. No. 70: National Electrical Code (NEC)
 - b. No. 72A: Local Protective Signaling Systems
- B. Acceptable Manufacturers: Products of the following manufacturers which comply with these specifications are acceptable.
 - 1. Edwards Division; EST
 - 2. Johnson Controls, Inc.
 - 3. Notifier
 - 4. Simplex
- C. Coordination:
 - 1. Review shop drawings submitted under this and other sections, as well as other divisions, to insure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications, and electrical equipment to insure access and so that clearance minimums are provided.

- D. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project.
 - 1. Firm with manufacturer's factory trained personnel.
 - 2. Firm with factory authorized service organization and spare parts stock.

1.4 SUBMITTALS

- A. Refer to BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.
- B. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of fire alarm system equipment. Include standard or typical riser and wiring diagrams, and operation and maintenance instructions for inclusion in maintenance manuals.
- C. Wiring Diagrams: Submit dimensioned floor plan drawings (minimum 1/16 inch scale) for each floor plan indicating all device locations with corresponding zone next to device. Zoning shall include initiation and audio zone where applicable. Plans shall include all conduit and wiring requirements indicating system interconnection, number and size of conductors and appropriate conduit size, and ancillary devices such as end-of-line resistors. Include wiring and riser diagrams.
- D. Isometric Detail: Provide isometric detail for Fire Alarm Control Panel indicating all component features and space requirements.
- E. Maintenance Data: Submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.
- F. Manufacturer Certification: Submit a letter from the manufacturer's representative stating the proposed system being submitted for review complies with the specification and takes no exception.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Handle fire alarm equipment carefully to prevent damage, breaking, and scoring. Do not install damaged equipment or components; replace with new.
- B. Store fire alarm equipment in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.1 FIRE ALARM AND DETECTION SYSTEMS:

- A. General: Provide complete fire alarm system products of types, sizes, and capacities indicated, which comply with manufacturer's standard design, materials, components; construct in accordance with published product information, and as required for complete installation. Provide fire alarm and detection systems for applications indicated.

1. Combination, Non-Coded: Either manual activation of fire alarm station or activation of automatic initiating device will energize fire alarm system signaling devices and sound non-coded alarm.
- B. Design system for alarm sounding continuously.
- C. System Wiring and Supervision:
 1. Provide Class 1 initiating and alarm circuits with electrical supervision for shorts and open conditions.
 2. Install diodes or resistors in fire alarm control cabinet.
 3. Power Supplies: Provide system for operation on 120 VAC power supply. Arrange control system for operation of primary power supply and trouble power supply to operate from opposite legs of three wire system.
 4. Provide battery back-up as secondary power supply. Design battery back-up to take over supply to system within 30 seconds of loss of primary system to 85% voltage. Provide battery system capable of operation of system for 24-hours under normal conditions and then for five minutes under alarm conditions.
- D. Optional System Features: Provide the following features in addition to the basic system features specified elsewhere in this specification
 1. Auxiliary contacts, normally open. Provide one contact for annunciation to SCADA system for alarm and trouble for all systems.
- E. System Materials: Provide basic wiring materials which comply with Division 16 Basic Electrical Materials and Methods sections, RACEWAYS and BOXES, types to be selected by Installer.
 1. Provide conductors which are listed and approved for fire alarm usage. All wiring shall be installed in conduit. Minimum size conduit shall be ¾".

2.2 SYSTEM OPERATION

- A. Actuation of any alarm initiation device shall automatically initiate the following:
 1. Illuminate the system priority one alarm LED, cause an audible alarm signal to sound, display the alarm condition language message for the point in alarm at the Central Control Station.
 2. Cause all alarms to sound, all visual alarms to flash.
- B. The fire alerting tone shall be a low to high "slow whoop" from 200 Hz to 830 Hz nominal lasting 2.5 seconds.
- C. It shall be possible to silence the alarm signals by operating the acknowledge switch causing the zone alarm LED to cease flashing and remain illuminated. However, the activation of another zone shall repeat the entire alarm process thus causing the signals to resound.

2.3 SYSTEM FEATURES

- A. The system shall include the following features as a minimum:
 1. All alarm initiating circuit wiring, signal circuit wiring, and alarm circuit wiring supervised.

2. Automatic transfer to standby batteries upon power failure.
3. Solid state, microprocessor based circuitry.
4. Full supervision of all communication, monitor and signal wiring.
5. User programmable with keyboard.
6. Modular design to allow future expansion with a minimum of hardware additions.
7. System automatically switches to battery operation upon loss of 60 Hz power.
8. Operation shall not require personnel with special computer operation skills.
9. All messages generated by the software shall be "user friendly" in plain English, not computer language. Messages shall describe condition and, based on input from the Owner, provide plain language instructions for building personnel.

2.4 FIRE ALARM PANEL

- A. Provide surface mounted fire alarm panels where shown. Panels shall include all controls and batteries to supervise and annunciate all devices.
- B. Provide limited panel feature for elevator area only.

2.5 MANUAL FIRE ALARM STATIONS

- A. Provide manufacturer's standard construction, red enclosure, manual fire alarm stations with the following features:
 1. High Impact Lexan
 2. Surface mounted
 3. Non-coded
 4. Non-breakglass operation
 5. General alarm
 6. Single action
 7. Institutional cover

2.6 HORNS/AUDIBLE

- A. Provide manufacturer's standard construction fire alarm horn with following features:
 1. Non-coded
 2. Surface mounted (with grille)
 3. Single projection
 4. Alarm light with white lens lettered red "FIRE"

2.7 ALARM LIGHTS

- A. Provide manufacturer's standard construction alarm lights with the following features:
 1. White lens, plain or lettered red "FIRE".
 2. 24-volt DC Xenon flasher.

2.8 SMOKE OR THERMAL DETECTORS

- A. Provide photoelectric smoke detectors or rate of rise thermal detector where shown. All to be addressable.

2.9 TEST CHART INSTRUCTIONS

- A. Provide fire alarm system test instructions chart mounted in lexan enclosed frame assembly on control cabinet hinged door.

2.10 STANDALONE SMOKE DETECTORS

- A. Provide 120 volt stand alone, photoelectric smoke detectors with integral horns where shown on drawings for sleeping area.

PART 3 - EXECUTION**3.1 EXAMINATION:**

- A. Examine areas and conditions under which fire alarm systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF BASIC IDENTIFICATION:

- A. Install electrical identification in accordance with Division-26 Basic Electrical Materials and Methods section "Electrical Identification."

3.3 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS:

- A. Install wiring, raceways, and electrical boxes and fittings in accordance with Division-26 Basic Electrical Materials and Methods sections, "Raceways", "Wires and Cables", and "Boxes" for wiring of non-power limited circuits. Conduit, boxes, etc shall be painted red.
- B. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.

3.4 INSTALLATION OF FIRE ALARM SYSTEMS:

- A. Install fire alarm system as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."
- B. Wiring: Wiring of fire alarm system is work of this section, but is not specifically detailed on drawings.

1. Complete wiring in accordance with manufacturer's requirements. Color code wiring and install per manufacturer's point-to-point wiring diagram. Determine exact number of wires for each fire area zone from number and types of devices installed. Connect each device with sufficient wiring to complete its intended operation.
2. Where there are a number of power requiring devices such as smoke detectors, fan relays, door holders and smoke damper operators installed in a circuit, group in numbers so power required does not exceed 80% of manufacturer's power supply rating. Provide extra wiring, or extra power supplies required to fulfill that requirement. In addition, provide extra or larger size wiring to alleviate voltage drops which makes device operate beyond voltage limits for which it was designed. Determine above with manufacturer's representative while equipment is being installed.

3.5 FIELD QUALITY CONTROL:

- A. Connection and Supervision: Make connections to panel under manufacturer's supervision. Run wiring to main terminal cabinet located adjacent to main fire alarm panel. Complete connections from this cabinet to panel utilizing Manufacturer's technicians.
- B. System Test and Approval: Submit shop drawings for function and operation only, pre-approved by authority having local jurisdiction.
 1. Prior to final acceptance of system, manufacturer of system shall, in presence of Contractor, Owner's Representative and Architect's representative, test each sensing or detection and alarm device.
 2. Submit copy of test results in duplicate after signed by Owner's Representative to Architect, Owner, Owner's Insurance Company and local Fire Protection Authority. Mount copy of inspection record in lexan enclosed frame assembly on control panel.
- C. Upon project completion, the manufacturer's representative shall present for the Owner's consideration a proposal to provide semi-annual inspection and tests of the system.

END OF SECTION 28 31 11.01

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse aggregate materials.
2. Fine aggregate materials.

B. Related Sections:

1. Section 31 20 00 Earth Moving.
2. Geotechnical Report

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
2. 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. ASTM International:

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 D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.

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

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work according to State of Georgia Department of Transportation standards.
- C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Aggregate Designation: 57
 - 1. Conform to the Georgia Department of Transportation.
 - 2. Percent Passing per Sieve Size:
 - a. 2 inches: n/a.
 - b. 1 1/2 inches: 100.
 - c. 1 inch: 95 to 100.
 - d. 3/4 inch: n/a.
 - e. 1/2 inch: 25 to 60.
 - f. 3/8 inches: n/a.
 - g. No. 4: 0 to 10.
 - h. No. 8: 0 to 5.
 - i. No. 16: n/a.
 - j. No. 100: n/a.
- B. Aggregate Designation: Riprap Class A
 - 1. Conform to the Georgia Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 - 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 0.75, Rock Size (lbs): 37, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 0.50, Rock Size (lbs): 11, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 0.20, Rock Size (lbs): 0.7, Percent of Riprap Smaller Than: 15.
- C. Aggregate Designation: Riprap Class B
 - 1. Conform to the Georgia Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 - 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 1.33, Rock Size (lbs): 200, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 1.0, Rock Size (lbs): 75, Percent of Riprap Smaller Than: 85.
 - c. Rock Size (ft): 0.75, Rock Size (lbs): 37, Percent of Riprap Smaller Than: 50.
 - d. Rock Size (ft): 0.42, Rock Size (lbs): 5, Percent of Riprap Smaller Than: 10.
- D. Aggregate Designation: Riprap Class C
 - 1. Conform to the Georgia Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
 - 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 1.80, Rock Size (lbs): 500, Percent of Riprap Smaller Than: 100.

- b. Rock Size (ft): 1.300, Rock Size (lbs): 200, Percent of Riprap Smaller Than: 50.
- c. Rock Size (ft): 0.40, Rock Size (lbs): 5, Percent of Riprap Smaller Than: 10.

E. Aggregate Designation: Riprap Class D

- 1. Conform to the Georgia Department of Transportation. *Standard Specifications for Highway Construction*, 2007, Section 800.
- 2. Provide riprap conforming to the gradation classes in the following:
 - a. Rock Size (ft): 2.25, Rock Size (lbs): 1000, Percent of Riprap Smaller Than: 100.
 - b. Rock Size (ft): 1.80, Rock Size (lbs): 500, Percent of Riprap Smaller Than: 50.
 - c. Rock Size (ft): 0.95, Rock Size (lbs): 75, Percent of Riprap Smaller Than: 10.

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate

- 1. Conform to State of Georgia Department of Transportation Standard
- 2. Aggregate No.: FA-10M.
- 3. Percent Passing per Sieve Size:

- a. 1/2 inch: n/a.
- b. 3/8 inches: 100.
- c. No. 4: 95 to 100.
- d. No. 8: 84 to 100.
- e. No. 16: 45 to 95.
- f. No. 30: 25 to 75.
- g. No. 50: 8 to 35.
- h. No. 100: 0.5 to 20.
- i. No. 200: 0 to 10*.

*Dust of fracture essentially free from clay or shale, final job site testing only.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Coarse Aggregate Material - Testing and Analysis: Perform according to AASHTO T96 or ASTM C131 and AASHTO T11.
- C. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM D1557 or AASHTO T180.
- D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 INSTALLATION OF RIP RAP

- A. All rip-rap shall be embedded in place so that the top surfaces are at the grade established for the surface of rip-rap. The inclusion of objectionable quantities of overburden and rock dust

will not be permitted. The rock fragments in rip-rap need not be compacted, but shall be dumped and graded off in a manner to ensure that the larger rock fragments are uniformly distributed and that the small rock fragments serve to fill the spaces between the layer of rip-rap of the specified thickness. Hand placing will be required only to the extent necessary to secure the results specified herein.

- B. Unless otherwise specified or shown, rip-rap shall have a minimum thickness of 12”.
- C. The CONTRACTOR shall maintain the rip-rap until accepted and any material displaced by any cause shall be replaced to the lines and grades shown on the plans.
- D. All rip-rap shall be underlain by an approved geotextile fabric to prevent erosion.

3.2 INSTALLATION OF CRUSHED STONE

- A. Crushed stone shall be placed in areas shown on the drawings. Stone shall be consolidated by mechanical means.
- B. Unless otherwise specified or shown, crushed stone shall have a minimum thickness of 6”.
- C. All crushed stone shall be underlain by an approved geotextile fabric to prevent erosion

3.3 STOCKPILING

- A. Stockpile materials on site at locations designated by Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.4 STOCKPILE CLEANUP

- A. Leave unused materials in neat, compact stockpile.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 05 16

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
8. Initial erosion and sedimentation control.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and as indicated on Drawings. Defined by a circle concentric with each tree with a radius 105 times the diameter of the drip line unless otherwise indicated.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct at Academy Creek WWTF

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Not allowed.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's property offsite.
- C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant protection measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."
 - 1. Obtain approved borrow soil material on-site for construction area as indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities, if required.
 - 2. Contractor will arrange to shut off indicated utilities that cannot be cut off by contractor (gas, electric, communication).
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting 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 not less than 2 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Arrange for temporary pumping if necessary, for sewer main work.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and stockpile in areas approved by Engineer.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 4 inches, or per Geotechnical Report, in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 1 inch in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for resspreading deeper topsoil.

3.6 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 72 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile Topsoil and reuse on lawn areas.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning: Not allowed.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities or abandoning site utilities in place.
8. Initial erosion and sedimentation control.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches (50 mm) in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and as indicated on Drawings. Defined by a circle concentric with each tree with a radius 105 times the diameter of the drip line unless otherwise indicated.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct at Academy Creek WWTF

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- E. Burning: Not allowed.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's property offsite.
- C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant protection measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."
 - 1. Obtain approved borrow soil material on-site for construction area as indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities, if required.
 - 2. Contractor will arrange to shut off indicated utilities that cannot be cut off by contractor (gas, electric, communication).
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting 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 not less than 2 days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Arrange for temporary pumping if necessary, for sewer main work.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and stockpile in areas approved by Engineer.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 4 inches, or per Geotechnical Report, in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 1 inch in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for resspreading deeper topsoil.

3.6 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 72 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile Topsoil and reuse on lawn areas.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning: Not allowed.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for process structures and buildings walks and pavements.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete walks and pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 01 32 00 "Construction Progress Documentation" Section 013233 "Photographic Documentation" for recording pre-excavation and earth-moving progress.
2. Section 03 30 00 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 31 23 19 "Dewatering" for lowering and disposing of ground water during construction.
5. Section 32 92 00 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
 - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
 - 2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.
 - 3. Blasting may be required for foundation preparation.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference:

- 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

- 1. Geotextiles.
- 2. Controlled low-strength material, including design mixture.
- 3. Geofoam.
- 4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

- 1. Geotextile: 12 by 12 inches.
- 2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and off-site soil material proposed for fill and backfill as follows:

- 1. Classification according to ASTM D 2487.
- 2. Laboratory compaction curve according to ASTM D 698.

C. Blasting plan approved by City of Milledgeville.

D. Seismic survey report from seismic survey agency.

- E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
 - 1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 - 2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf ; ASTM D 4632.
 - b. Sewn Seam Strength: 142 lbf ; ASTM D 4632.
 - c. Tear Strength: 56 lbf ; ASTM D 4533.
 - d. Puncture Strength: 56 lbf ; ASTM D 4833.
 3. Apparent Opening Size: No. 40, No. 60 sieve, maximum; ASTM D 4751.
 4. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Survivability: As follows:
 - a. Grab Tensile Strength: 247 lbf ; ASTM D 4632.
 - b. Sewn Seam Strength: 222 lbf ; ASTM D 4632.
 - c. Tear Strength: 90 lbf ; ASTM D 4533.
 - d. Puncture Strength: 90 lbf ; ASTM D 4833.
 3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
 4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
1. Portland Cement: ASTM C 150/C 150M, Type I.
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/4-inch, or 3/8-inch nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869/C 869M.
 5. Water: ASTM C 94/C 94M.
 6. Air-Entraining Admixture: ASTM C 260/C 260M.
- B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: 30 to 36 lb/cu. ft., or 36 to 42 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
 2. Compressive Strength: 80 psi, or 140 psi, when tested according to ASTM C 495/C 495M.
- C. Produce conventional-weight, controlled low-strength material with 80-psi 140-psi compressive strength when tested according to ASTM C 495/C 495M.

2.4 GEOFOAM (NOT USED)

2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Not Allowed

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

- a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches beneath bottom of concrete slabs-on-grade.
 - f. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to minimum 12 inches higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs, plant structures and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, sub drainage, damp proofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring, bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 - 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.
- G. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
 - 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
 - C. Place soil fill on subgrades free of mud, frost, snow, or ice.
- 3.14 GEOFOAM FILL (NOT USED)
- 3.15 SOIL MOISTURE CONTROL
- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
- 3.16 COMPACTION OF SOIL BACKFILLS AND FILLS
- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
 - B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
 - C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 95
- 3.17 GRADING
- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
1. Turf or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1/2 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
 2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 3. Determine, during placement and compaction that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes construction dewatering.
- B. Related Requirements:
 - 1. Section 31 20 00 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 ALLOWANCES

- A. Dewatering observation wells are part of dewatering allowance.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Academy Creek WPCF
 - 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
 - 3. Review geotechnical report.
 - 4. Review proposed site clearing and excavations.
 - 5. Review existing utilities and subsurface conditions.
 - 6. Review observation and monitoring of dewatering system.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.8 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 2. The geotechnical report is included elsewhere in Project Manual.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to

lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 5. Remove dewatering system when no longer required for construction.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 01 50 00 Temporary Facilities and Controls, and Section 31 10 00 Site Clearing during dewatering operations.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 - 3. Maintain piezometric water level a minimum of 24 inches 60 inches below bottom of excavation.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Survey-Work Benchmarks: Resurvey benchmarks regularly/monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- D. Prepare reports of observations.

3.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 23 19

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction Entrance/Exits
2. Diversion Channels.
3. PAM
4. Rock Energy Dissipator.
5. Rock Barriers.
6. Sediment Control: including silt fences, inlet protection, etc.
7. Sediment Ponds.
8. Sediment Traps.
9. Silt Fences

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete.
2. Section 05 50 00 – Metal Fabrications.
3. Section 31 05 16 – Aggregates for Earthwork.
4. Section 32 13 13 – Concrete Paving.
5. Section 32 91 13 – Soil Preparation.
6. Section 32 92 00 – Turf and Grasses.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
2. 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 Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.

C. ASTM International:

1. ASTM C127 - Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
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 D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³).

4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. Precast/Prestressed Concrete Institute:

1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

E. Georgia Department of Transportation Standard Specifications for Highway Construction.

F. Georgia Environmental Protection Division Stormwater Management Manual including the Coastal Stormwater Supplement.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Product Data: Submit data on joint filler, joint sealer, admixtures, curing compounds, and geotextiles.
- C. Submit proposed mix design of each class of concrete for review prior to commencement of Work.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.5 QUALITY ASSURANCE

- A. Perform Work according to State of Georgia Highways standards.

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum one (1) week prior to commencing work of this section.

PART 2 - PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

- A. Furnish materials according to Georgia EPD and GDOT

- B. Rock: As specified in Section 31 05 16 – Aggregates for Earthwork. Furnish according to State of Georgia Highways standards.
- C. Geotextile Fabric: As specified in Section 31 20 00 – Earth Moving. Furnish according to State of Georgia Highways standards.

2.2 CONCRETE MATERIALS AND REINFORCEMENT

- A. Cement: As specified in Section 03 30 00 – Cast-in-Place Concrete.

2.3 PLANTING MATERIALS

- A. Seeding and Soil Supplements: As specified in Section 32 91 13 – Soil Preparation.
- B. Turf and Grasses: As specified in Section 32 92 00 – Turf and Grasses.

2.4 POLYACRYLAMIDE (PAM)

- A. Only the anionic form of PAM shall be used. PAM and PAM mixtures shall be environmentally benign, harmless to fish, wildlife, and plants.
- B. Anionic PAM in pure form shall have less than or equal to 0.05% acrylamide monomer by weight, as established by the FDA and US EPA.

2.5 MATS AND BLANKETS (ECB's)

- A. 3:1 Slopes and flatter
 - 1. ECB must be rated for shear stresses up to 1.55 lbs./sq ft, must weigh at least 0.50 lbs/yd², and the netting made of biodegradable polypropylene
- B. 1.5:1 to 3:1 Slopes
 - 1. ECB must be rated for shear stresses up to 1.75 lbs/sq ft, must weigh at least 0.73 lbs/yd², and the netting made of biodegradable polypropylene
- C. Acceptable manufacturer
 - 1. American Excelsior Company, Arlington, TX
 - 2. Or approved equal.
- D. Inlet Protection Products
 - 1. Drop Inlets
 - a. Silt Savers
 - b. Dandy Sacks
 - c. Or approved equal.

2. Curb Inlet
 - a. Dandy Curb
 - b. Gutter Eel
 - c. Or approved equal
3. The filter shall be a weighted sediment tube filter with a diameter of 9.5-inches at the ends and tapering to 5 inches in the center. Lengths shall be 6 to 9 feet with a build-in triangular overflow for relief during high-intensity storm events.
 - a. Unit Weight: 13 lbs/ft
 - b. Interior Filter
 - c. Materials: Shredded, recycled tire rubber particles with less than 2% metal and the rubber shall be washed during manufacturing.
 - d. Particle Size: ½ inch to ¾ inch particle size
 - e. Geotextile Bag
 - 1) Percent Open Area: 8%
 - 2) Apparent Opening Size: 30 U.S. Sieve
 - 3) Grab Tensile Strength: 400 lbs
 - 4) Flow Rate: 115 gal/min/ft²
 - 5) Puncture Strength: 125 lbs

E. Fiber Rolls

1. Fiber rolls should be prefabricated rolls or rolled tubes of geotextile fabric. When rolling the tubes, make sure each tube is at least 8 inches in diameter. Bind the rolls at each end and every 4 feet along the length of the roll with jute-type twine

F. Silt Fence

1. The height of a silt fence shall not exceed 36 inches (0.9 m). Storage height and ponding height shall never exceed 18 inches (0.5 m).
2. The standard-strength filter fabric shall be stapled or wired to the fence, and 6 inches (0.2 m) of the fabric shall extend into the trench.
3. Type A Silt Fence
 - a. A wire mesh support fence shall be fastened securely to the upslope side of the posts (between the posts and fabric) using heavy duty wire staples at least ½” (12.7mm) long and ¾” wide, tie wires or hog rings. The wire shall extend into the trench a minimum of 6 inches (51 mm) and shall not extend more than 36 inches (0.9 m) above the original ground surface.
 - b. Posts shall be 4’ long steel that each weigh at least 5.2 lbs.
4. Type B Silt Fence
 - a. The spacing between posts shall be a maximum of 6’, and the filter fabric shall be stapled or wired directly to the posts.
 - b. Posts may be soft wood 2x4, oak 2x2, or steel as indicated for Type A Silt Fence.

2.6 PIPE MATERIALS

- A. Pipe: Corrugated steel, as specified in the State Highways standards.

2.7 ACCESSORIES

- A. Trash Rack: Bars welded to angles and at each intersection of bars, as specified in Section 05 50 00 – Metal Fabrications.

2.8 SOURCE QUALITY CONTROL (AND TESTS)

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify compacted stabilized soil is acceptable and ready to support devices and imposed loads.
- B. Verify gradients and elevations of base or foundation for other work are correct.

3.2 DIVERSION CHANNELS

- A. Windrow excavated material on low side of channel.
- B. Compact to 95 percent maximum density.
- C. On entire channel area, apply soil supplements and sow seed as specified in Section 32 92 00 – Turf and Grasses.
- D. Mulch seeded areas with hay as specified in Section 32 92 00 – Turf and Grasses.

3.3 POLYACRYLAMIDE (PAM)

- A. The maximum application rate of PAM in pure form shall not exceed 200 lbs/acre/year. Over application of PAM can lower infiltration rates or suspend solids in water, and, therefore, over application should be avoided.
- B. Users of PAM shall obtain and follow all MSDS requirements.
- C. The manufacturer or supplier shall provide written application methods for PAM and PAM mixtures. The application shall provide uniform coverage to the target area.

3.4 MATS AND BLANKETS

- A. After the site has been shaped and graded to the approved design, prepare a seedbed free from clods and rocks more than 1 inch in diameter, and any foreign matter that will prevent the contact of the mat with the soil surface.
- B. Lime, fertilizer, and seed shall be applied in accordance with seeding or other type of planting plan as suggested by the Engineer.
- C. Erosion control blanket products should be installed in accordance with the manufacturer's recommendations and specifications, including check slots and stapling materials.
- D. Anchor product so that a continuous, firm contact with the soil surface/seed bed is maintained. This is best accomplished on slopes by working from the bottom to the top.

3.5 SEDIMENT CONTROL

- A. Filter Ring/Rock Filter Ring
 - 1. Mechanical or hand placement of fiber rolls/straw wattles/stone shall be required to uniformly surround the structure to be supplemented.
 - 2. The filter ring may be constructed on natural ground surface, excavated surface, or on machine compacted fill.
 - 3. When placed below a storm drain outlet, it shall be constructed so that it does not allow water to back up into the storm drain.
- B. Inlet Protection Products
 - 1. For information on installation, refer to the manufacturers' drawings provided by the distributor. Strict adherence to the manufacturers' suggested installation procedures is required for proper inlet protection.
- C. Fiber Rolls
 - 1. On slopes, install fiber rolls along the contour with a slight downward angle at the end of each row to prevent ponding at the midsection. Turn the ends of each fiber roll upslope to prevent runoff from flowing around the roll. Install fiber rolls in shallow trenches dug 3 to 5 inches deep for soft, loamy soils and 2 to 3 inches deep for hard, rocky soils.
 - 2. Determine the vertical spacing for slope installations on the basis of the slope gradient and soil type. A good rule of thumb is:
 - a. 1:1 slopes = 10 feet apart
 - b. 2:1 slopes = 20 feet apart
 - c. 3:1 slopes = 30 feet apart
 - d. 4:1 slopes = 40 feet apart
 - 3. For soft, loamy soils, place the rows closer together. For hard, rocky soils, place the rows farther apart. Stake fiber rolls securely into the ground and orient them perpendicular to the slope. Drive the stakes through the middle of the fiber roll and deep enough into the ground to anchor the roll in place. About 3 to 5 inches of the stake should stick out above

the roll, and the stakes should be spaced 3 to 4 feet apart. A 24-inch stake is recommended for use on soft, loamy soils. An 18-inch stake is recommended for use on hard, rocky soils.

D. Rock Filter Dam

1. The center of the rock dam should be at least 6" lower than the outer edges of the dam at the channel banks. Side slopes shall be 2:1 or flatter. The top width of the dam should be at least 6'.
2. The dam should not be higher than the channel banks or the elevation of the upstream property line.
3. Set a marker stake to indicate the clean out elevation.

3.6 CONSTRUCTION ENTRANCE/EXIT

- A. The entrance/exit must be excavated to a depth of 3 inches and cleared of all vegetation and roots.
- B. If the action of the vehicle travelling over the gravel pad does not sufficiently remove the mud, the tires should be washed prior to entrance onto public rights-of-way. When washing is necessary, it should be done on an area stabilized with crushed stone.
- C. A geotextile fabric underliner should be placed the full length and width of the entrance.

3.7 ROCK ENERGY DISSIPATOR

- A. Excavate to indicated depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.
 1. Nominal Placement Thickness per NCSA Class:
 - a. R7: 36 Inches
 - b. R6: 30 Inches
 - c. R5: 24 Inches
 - d. R4: 18 Inches
 - e. R3: 12 Inches
- B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.
- C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile.
- D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

3.8 ROCK BARRIER

- A. Determine length required for ditch or depression slope and excavate, compact and foundation area to firm, even surface.
- B. Produce an even distribution of rock pieces, with minimum voids to the indicated shape, height and slope.
- C. Construct coarse aggregate filter blanket against upstream face of rock barrier to the indicated thickness.

3.9 SEDIMENTATION POND

- A. Clear and grub storage area and embankment foundation area site as indicated and specified.
- B. Excavate key trench for full length of dam. Excavate emergency spillway in natural ground.
- C. Install pipe spillway, with anti-seep collar attached, at location indicated.
- D. Place forms, and reinforcing for concrete footing at bottom of riser pipe with trash rack and anti-vortex device. Construction of embankment and trench prior to placing pipe is not required.
- E. Mix, place, finish, and cure concrete, as specified in Section 03 30 00 – Cast-in-Place Concrete.
- F. Do not use coarse aggregate as backfill material around pipe. Backfill pipe with suitable embankment material to prevent dam leakage along pipe.
- G. Construct rock basin at outlet end of pipe. Place embankment material, as specified.
- H. On entire sedimentation pond area, apply soil supplements and sow seed as specified in Section 32 92 00 – Turf and Grasses.
- I. Mulch seeded areas with hay.
- J. Apply PAM.

3.10 SEDIMENT TRAPS

- A. Clear site, as indicated.
- B. Construct trap by excavating and forming embankments as indicated in the drawings.
- C. Place coarse aggregate or rock at outlet as indicated on Drawings.
- D. Place geotextile fabric, as specified for rock energy dissipator.
- E. When required, obtain borrow excavation for formation of embankment.
- F. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 32 92 00 – Turf and Grasses.

- G. Mulch seeded areas with hay.

3.11 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.12 FIELD QUALITY CONTROL & INSPECTIONS

- A. Section 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. It is the Contractor's responsibility to perform all required inspections in accordance with all Authorities having Jurisdiction.
- E. The Contractor is responsible for continually maintaining all temporary erosion control measures until permanent measures are properly installed and performing as required.

3.13 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.14 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- C. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION 31 25 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
 - 1. Section 31 20 00 – Earth Moving
 - 2. Section 31 23 19 – Dewatering for dewatering excavations.
 - 3. Section 31 23 16.13 – Excavation & Trenching

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer in the state of Georgia.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by

inadequate performance of excavation support and protection systems. Submit before Work begins.

- C. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Engineer no fewer than two (2) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Engineer's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- F. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- G. Tiebacks: Steel bars, ASTM A 722/A 722M.
- H. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of

flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

- A. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

- B. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill compacted to density specified in Division 31 and as required by the geotechnical engineer.
 - 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hot-mix asphalt patching.
 - 2. Hot-mix asphalt paving.
 - 3. Hot-mix asphalt overlay.
 - 4. Pavement marking paint.
- B. Related Requirements:
 - 1. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
 - 2. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.
 - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
 - 2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
 - 3. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Material Certificates: For each paving material. *Mixes containing recycled materials will perform equal to mixes produced from all new materials.*
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or Georgia DOT.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Georgia DOT for asphalt paving work.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
 - 3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
- B. Pavement Marking Paint: Proceed on clean and dry pavement only at a minimum ambient or surface temperature of 40 deg F for oil based material and 60 deg F for water based material; not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.

- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, Georgia Department of Transportation 19.5 mm binder.
- B. Asphalt Cement: Georgia Department of Transportation 12/5 mm superpave ASTM D 3381/D 3381M for viscosity-graded material.
- C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30.
- D. Emulsified Asphalt Prime Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- G. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D 1073, Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

- F. Pavement-Marking Paint in accordance with Georgia Department of Transportation standard pavement markings. Select from colors below; distinguish locations if more than one color is required.
- G. GDOT approved thermoplastic striping (arrows, gore, stop bars) as indicated on plans per GDOT English details.

2.4 MIXES

- A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent or more than 15 percent by weight.
 - 1. Surface Course Limit: Recycled content no more than 10 percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by City of Milledgeville and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
 - 2. Base Course: GDOT "B" Binder, 19mm.
 - 3. Surface Course: GDOT 9.5 superpave or 12.5 mm superpave as specified in section.
- C. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material according to approved waste management site.
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.3 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.20 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.

- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PAVING GEOTEXTILE INSTALLATION

- A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd.
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.6 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at a minimum temperature of 250 deg F.
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course before placing asphalt surface course.

- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent or greater than 100 percent.
 - 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.10 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
 - 1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Additional testing will be at Contractor's expense.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 024119 "Selective Demolition."

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Concrete Paving. Including the following:
 - 1. Driveways.
 - 2. Curbs and gutters.
 - 3. Walks.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.
 - 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.

- c. Ready-mix concrete manufacturer.
- d. Concrete paving Subcontractor.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420); deformed.
- C. Plain-Steel Wire: ASTM A 1064, as drawn galvanized.
- D. Joint Dowel Bars: ASTM A 615, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- E. Tie Bars: ASTM A 615, Grade 60 (Grade 420); deformed.
- F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C 150, gray white Portland cement Type I, Type II, or Type I/II
 - 2. Fly Ash: ASTM C 618, Class F.
 - 3. Slag Cement: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4M Class 1N, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260.
- D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.

2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.6 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash or Pozzolan: 25 percent.
 2. Slag Cement: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 1. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.
 2. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.
 3. Air Content: 5 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing admixture or plasticizing and retarding admixture in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Concrete Mixtures: Normal-weight concrete.
 1. Compressive Strength (28 Days): 4000 psi
 2. Maximum W/C Ratio at Point of Placement: 0.50
 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Furnish batch certificates for each batch discharged and used in the Work.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction (Control) Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

- a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
- 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet- long; unlevelled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied joint sealants.
 - 2. Hot-applied joint sealants.
 - 3. Cold-applied, fuel-resistant joint sealants.
 - 4. Hot-applied, fuel-resistant joint sealants.
 - 5. Joint-sealant backer materials.
 - 6. Primers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Paving-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of joint sealant and accessory.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.
 - 1. Crafc0, or equal.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.
 - 1. Crafc0, or equal.
- C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 - 1. W.R. Meadows, or equal.
- D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 - 1. W.R. Meadows, or equal.

- E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

- 1. Pecora Corporation, or equal.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I.

- 1. Crafc0, or equal.

- B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.

- 1. Crafc0, or equal.

- C. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.

- 1. Crafc0, or equal.

- D. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type IV.

- 1. Crafc0, or equal.

2.4 COLD-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Fuel-Resistant, Single-Component, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

- 1. BASF Corp., or equal.

- B. Fuel-Resistant, Multicomponent, Pourable, Modified-Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 12-1/2 or 25, for Use T.

- 1. Pecora Corp., or equal.

2.5 HOT-APPLIED, FUEL-RESISTANT JOINT SEALANTS

- A. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D 7116, Type I or Type II.

- 1. Crafc0, or equal.

- B. Hot-Applied, Fuel-Resistant, Single-Component Joint Sealants: ASTM D 7116, Type III.

- 1. Crafc0, or equal.

2.6 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.7 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Joints within concrete paving.
 - 1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Multicomponent, nonsag, urethane, elastomeric joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.
- B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.
 - 1. Joint Location:
 - a. Joints between concrete and asphalt paving.
 - b. Joints between concrete curbs and asphalt paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: Hot-applied, single-component joint sealant.
 - 3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION 32 13 73

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences.
 - 2. Swing gates.

- B. Related Requirements:

- 1. Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads for gate operators and controls and post footings.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Barbed wire.
 - d. Gates and hardware.

- B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include accessories, hardware, gate operation, and operational clearances.
 - 3. Wiring Diagrams: For power, signal, and control wiring.

- C. Samples for Initial Selection: For each type of factory-applied finish.

- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For factory-authorized service representative.
- B. Product Certificates: For each type of chain-link fence, operator, and gate.
- C. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
 1. Design Wind Load: 80 mph.
 - a. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed 10 feet Schedule 40 steel pipe.
 - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
- C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
 1. Fabric Height: As indicated on Drawings.
 2. Steel Wire for Fabric: Wire diameter of 0.148 inch.
 - a. Mesh Size: 2 inches.
 - b. Polymer-Coated Fabric: ASTM F 668, Class 1, with zinc coating applied over zinc coated steel wire.
 - 1) Color: Match existing plant fence.
 3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:
1. Fence Height: 72 inches.
 - a. Line Post: 2 inches.
 - b. End, Corner, and Pull Posts: 2.375 inches.
 2. Horizontal Framework Members: Intermediate top and bottom rails according to ASTM F 1043.
 - a. Top Rail: 1.66 inches in diameter.
 3. Brace Rails: ASTM F 1043.
 4. Metallic Coating for Steel Framework:
 - a. Type A: Not less than minimum 2.0-oz./sq. ft. average zinc coating according to ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating according to ASTM A 653/A 653M.
 - b. Type C: Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
 - c. Coatings: Any coating above.
 5. Polymer coating over metallic coating.
 - a. Color: Match chain-link fabric, according to ASTM F 934

2.4 TENSION WIRE

- A. Polymer-Coated Steel Wire: 0.177-inch diameter, tension wire according to ASTM F 1664, Class 1 over zinc-coated steel wire.
- a. Color: Match chain-link fabric, according to ASTM F 934.

2.5 SWING GATES

- A. General: ASTM F 900 for gate posts and double swing gate types. Provide automated vehicular gates according to ASTM F 2200.
1. Gate Leaf Width: as shown on the drawings (not less than 36 inches).
 2. Framework Member Sizes and Strength: Based on gate fabric height of 72 inches as indicated.
- B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framework.
 2. Gate Posts: Round tubular steel.
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded assembled with corner fittings.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend 12 inches above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
- E. Hardware:
1. Hinges: See Plans for swing.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 3. Lock: Manufacturer's standard internal device.
 4. Padlock and Chain: Manufacturer's standard.
 5. Closer: Manufacturer's standard.

2.6 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
1. Top Rail Sleeves: Pressed-steel or round-steel tubing.
 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Barbed Wire Arms: Pressed steel or cast iron, with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts for each post unless otherwise indicated, and as follows:

1. Provide line posts with arms that accommodate top rail or tension wire.
2. Provide corner arms at fence corner posts unless extended posts are indicated.
3. Single-Arm Type: Type I, slanted arm.

I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.106-inch diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

J. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.
2. Aluminum: Mill finish.

2.7 BARBED WIRE

- A. Steel Barbed Wire: ASTM A 121, two-strand barbed wire, 0.099-inch diameter line wire with 0.080-inch diameter, four-point round barbs spaced not more than 5 inches o.c.
 1. Zinc Coating: Type Z, Class 3.

2.8 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.9 GROUNDING MATERIALS

- A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 1. Connectors for Below-Grade Use: Exothermic welded type.

2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Place top of concrete 2 inches below grade as indicated on Drawings to allow covering with surface material.
 - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

- d. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- 3. Mechanically Driven Posts: Drive into soil to depth of 30 inches. Protect post top to prevent distortion.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 96 inches o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid-height of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 - 1. As indicated on Drawings.
- H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- I. Intermediate and Bottom Rails: Secure to posts with fittings.
- J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach

other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- N. Barbed Wire: Install barbed wire uniformly spaced, angled toward security side of fence as indicated on Drawings. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.
- O. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GATE-OPERATOR INSTALLATION

- A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.
- C. Vehicle Loop Detector System: Cut grooves in pavement, bury, and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

3.6 GROUNDING AND BONDING

- A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Fence and Gate Grounding:
 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 2. Install ground rods and connections at maximum intervals of 1500 feet.

3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- F. Connections:
 1. Make connections with clean, bare metal at points of contact.
 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 4. Make above-grade ground connections with mechanical fasteners.
 5. Make below-grade ground connections with exothermic welds.
 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 32 31 13

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes planting soils and layered soil assemblies specified by composition of the mixes.
- B. Related Requirements:
 - 1. Division 31 - Earthwork
 - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.

1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.
 - 4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SU1P #25.
 - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.6 INFORMATIONAL SUBMITTALS

- A. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- B. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.
 - 1. Notify Engineer seven days in advance of the dates and times when the contractor requests samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
 - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Engineer under the direction of the testing agency.
 - 1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
 - 2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
 - 3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
 - 4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
 - b. Hydrometer Method: Report percentages of sand, silt, and clay.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT SERA-6, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Do not move or handle materials when they are wet or frozen.
 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type: Provide offsite topsoil or amend existing, on-site surface soil, with the duff layer, if any, retained; modified to produce viable planting soil. Blend existing, on-site surface soil with the soil amendments and fertilizers required for the topsoil to have the following qualities or provide from offsite as follows:
1. Fertile, friable, naturally occurring. Free of stones, clay, lumps, hardpan, roots, stumps, branches, sticks and other debris larger than one inches in any dimension; free of noxious weeds, grasses, seeds, plants, extraneous matter and any substance harmful to plant growth. Topsoil from open fields will not be accepted.
 2. Ph: 5.0 to 7.0
 3. Organic Matter: 5% to 10%
 4. Sand: 50% to 70%

5. Silt: less than 30%
6. Clay: 10% to 25%
7. Permeability Rate of 5×10^{-3} centimeters or greater at 85% compaction.
8. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
9. Unacceptable Properties: Clean soil of the following:
 - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
 3. Form: Provide lime in form of ground dolomitic limestone or calcitic limestone.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 1. Feedstock: May include sewage sludge.
 2. Reaction: pH of 5.5 to 8.

3. Moisture Content: 35 to 55 percent by weight.
 4. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.

- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 5 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth of 4 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
 - a. Mix lime with dry soil before mixing fertilizer.
 - b. Mix fertilizer with planting soil no more than seven days before planting.
 - 2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than in loose depth for material compacted by hand-operated tampers.

- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is required due to use or as directed by the Engineer.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 4 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place except where a different compaction value is required due to use or as directed by the Engineer.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply compost component of planting-soil mix 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

- B. Perform the following tests and inspections:
 - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 2000 sq. ft. of in-place soil or part thereof.
- C. Soil will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

- A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Engineer and replace contaminated planting soil with new planting soil.

3.8 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 32 91 13

SECTION 32 92 00 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydroseeding.
 - 3. Erosion-control material(s).

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of suppliers.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawncare Manager.
 - c. Landscape Industry Certified Lawncare Technician.
5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 1. Spring Planting: April – August.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
 1. Quality: State-certified seed of grass species as listed below for solar exposure.
 2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 3. Bermudagrass (*Cynodon dactylon*) or Centipedegrass (*Eremochloa ophiuroides*) with 10 percent perennial ryegrass (*Lolium perenne*).

2.2 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.4 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydro mulching overspray.

2. Protect grade stakes set by others until directed to remove them.

- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.4 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at total rate specified in the current Georgia Manual for Erosion and Sedimentation Control.
- C. Rake seed lightly into top 1/4 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1 inch in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- F. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, commercial fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.6 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.
1. Use fertilizer that provides actual nitrogen of at least 2 lb/1000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Engineer:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.8 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 1. Seeded Turf: 60 days from date of planting completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 32 92 00

SECTION 33 01 30.13 - SEWER AND MANHOLE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing of Gravity Sewer Piping:
 - a. Low pressure air testing.
 - b. Joint Testing
 - c. Infiltration testing.
2. Exfiltration testing for water retaining structures
3. Testing of pressure piping.
4. Deflection testing of plastic sewer piping.
5. Vacuum testing of manholes:

B. Related Requirements:

1. Section 33 31 00 - Sanitary Utility Sewerage Piping
2. Section 33 05 13 – Manholes and Structures

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM C1103 – Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
2. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
3. ASTM C1244M - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
4. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
5. ASTM F1417 – Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.
6. ASTM F2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure.

B. American Water Works Association:

1. AWWA C600 - Installation of Ductile Iron Mains and Their Appurtenances.

C. PVC Pipe Association

1. UNI-B-06-Recommended Low-Pressure Air Testing of Installed Sewer Pipe.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Submit following items prior to start of testing:
 1. Testing procedures.
 2. List of test equipment.
 3. Testing sequence schedule.
 4. Provisions for disposal of flushing and test water.
 5. Certification of test gage calibration.
 6. Deflection mandrel drawings and calculations.
 7. Testing Safety Plan describing safety precautions to be taken during testing.
- C. Test and Evaluation Reports: Indicate results of manhole and piping tests on a form acceptable to the engineer. Use the attached forms for:
 1. Low pressure air test
 2. Vacuum test
 3. Pipe Pressure / Leakage Test
- D. The Engineer or his representative shall witness all pipe and manhole testing in order to confirm the passage or failure of all tests. The Contractor shall be responsible to confirm the Engineer's availability to witness all testing.

PART 2 - PRODUCTS

2.1 VACUUM TESTING

- A. Equipment:
 1. Vacuum pump.
 2. Vacuum line.
 3. Vacuum Tester Base:
 - a. Compression band seal.
 - b. Outlet port.
 4. Shutoff valve.
 5. Stopwatch.
 6. Plugs.
 7. Vacuum Gage: Calibrated to 0.1 in. Hg.

2.2 JOINT TESTING

1. Vacuum pump.
2. Vacuum line.
3. Joint Tester
4. Shutoff valve.
5. Stopwatch.
6. Plugs.
7. Vacuum Gage: Calibrated to 0.1 in. Hg.

2.3 EXFILTRATION TESTING

A. Equipment:

1. Water
2. Plugs.
3. Pump.
4. Measuring device.

2.4 AIR TESTING

A. Equipment:

1. Air compressor.
2. Air supply line.
3. Shutoff valves.
4. Pressure regulator.
5. Pressure relief valve.
6. Stopwatch.
7. Plugs.
8. Pressure Gage: Calibrated to 0.1 psi.

2.5 INFILTRATION TESTING

A. Equipment: N/A

2.6 HYDROSTATIC TESTING

A. Equipment:

1. Hydro pump.
2. Pressure hose.
3. Water meter.
4. Test connections.
5. Pressure relief valve.
6. Pressure Gage: Calibrated to 0.1 psi.

2.7 DEFLECTION TESTING

A. Equipment:

1. "Go, no go" mandrels (9 arm).
2. Pull/retrieval ropes.

PART 3 - EXECUTION

3.1 GENERAL

- A. On Completion of each block or section of sewer, or such other time as the Engineer may direct, the block or section of sewer is to be cleaned, tested, and inspected.
- B. All repairs shown necessary by testing are to be made and re-tested. If satisfactory repairs cannot be made, the failed pipe, manholes, or appurtenance shall be replaced at no additional cost to the Owner.

3.2 EXAMINATION

- A. Verify that manholes and piping are ready for testing.
- B. Verify that trenches are backfilled.
- C. Verify that pressure piping thrust restraint system is installed.
- D. When construction of the sewers has been completed, lines shall be substantially dry, and there shall be no visible infiltration of groundwater or surface water into sewer lines or manholes.
- E. "0" infiltration is the requirement.
- F. All infiltration checks shall be made by the Contractor in the presence of the Engineer or assigned representative. All expenses for the tests shall be borne by the Contractor.
- G. Leakage into or out of the sewers, including connecting laterals, shall not be tolerated. If infiltration or leakage is present, the sewer will not be accepted until so repaired that it will comply with these requirements.

3.3 PREPARATION

A. Cleaning

1. Clean and flush pipes and manholes prior to testing.
2. All manhole lift holes shall be plugged with approved non-shrink grout and allowed to cure prior to testing.

- B. All deposits shall be removed, the sewers left true to line and grade and herein specified or shown on plans, entirely clean, free from dirt, etc., ready to use.
- C. Lamping of Gravity Pipe:
 - 1. Lamp gravity piping after flushing and cleaning.
 - 2. Perform lamping operation by shining light at one end of each pipe section between manholes.
 - 3. Observe light at other end.
 - 4. A full circle of light for each section of sewer between manholes shown from either end shall be verification of sufficient cleaning, and uniform line and grade.
 - 5. Pipe not installed with uniform line and grade will be rejected.
 - 6. Remove and reinstall rejected pipe sections.
 - 7. Reclean and lamp until pipe section is installed to uniform line and grade.
 - a. All additional cleaning and lamping water will be supplied by the Contractor at no additional cost to the Owner
- D. Plugs:
 - 1. Plug outlets, wye branches, and laterals.
 - 2. Brace plugs to resist test pressures.

3.4 TESTING

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Deflection Testing of Plastic Sewer Piping:
 - 1. Conduct deflection test prior to low pressure air test.
 - 2. Perform vertical ring deflection testing on non-rigid piping (thermoplastic, FRP, and acrylonitrile butadiene styrene) after backfilling has been in place for at least 30 days but not longer than 12 months.
 - 3. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
 - 4. Perform deflection testing using properly sized rigid ball or 9 arm "go, no go" mandrel.
 - 5. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured; measure pipe diameter in compliance with ASTM D2122.
 - 6. The critical dimensions of the rigid ball or mandrel shall have a +/- 0.01 inch tolerance.
 - 7. Perform testing without mechanical pulling devices.
 - 8. Locate, excavate, replace, and retest piping that exceeds allowable deflection at no additional cost to the Owner.
- C. Low-Pressure Air Testing:
 - 1. Test each reach of gravity sewer piping between manholes in accordance with ASTM F1417 and UNI B-6-90.
 - 2. Introduce air pressure slowly to approximately 4 psig.

3. Determine ground water elevation above spring line of piping.
4. For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
5. Do not increase pressure above 10 psig.
6. Allow pressure to stabilize for at least five minutes.
7. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
8. Do not make allowance for laterals.
9. The time elapsed for a 0.5 psi drop in air pressure shall be not less than 10 minutes or as specified in ASTM F1417 or UNI B-6-90 whichever is greater.
10. Record drop in pressure during testing period.
11. If air pressure drops more than 1.0 psi during testing period, piping has failed.
12. If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
13. If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.

D. Joint Testing of Pipes Larger than 27" in Diameter

1. For pipes large enough to enter (27" in diameter or larger), individual joints may be pressure tested with a portable tester to 5 psi maximum, with air or water in lieu of low pressure air testing.
2. Joint Testing shall be performed in accordance with ASTM C1103.

E. Infiltration Testing:

1. All lines shall be checked for infiltration
2. "0" infiltration is the requirement.
3. All infiltration checks shall be made by the Contractor in the presence of the Engineer or assigned representative. All expenses for the tests shall be borne by the Contractor.
4. Leakage into or out of the sewers, including connecting laterals, shall not be tolerated. If infiltration or leakage is present, the sewer will not be accepted until so repaired that it will comply with these requirements.
5. If at any time prior to expiration of the correction period stipulated in the General Condition, infiltration exists, that is any inflow, and the pipe fails.
6. The Contractor shall locate the leaks and make repairs as necessary to remove the infiltration.

F. Testing of Pressure Piping:

1. PE and HDPE pipe will be tested in accordance with ASTM F2164.
2. Test all other pipe material systems according to AWWA C600 and following:
 - a. Hydrostatically test each portion of pressure piping, including valved section, at 1.5 times working pressure of piping, based on elevation of lowest point in piping corrected to elevation of test gage.
 - b. Conduct hydrostatic testing for at least two hours.
 - c. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.
 - d. Install corporation cocks at high points.

- e. Close air vents and corporation cocks after air is expelled.
 - f. Raise pressure to specified test pressure.
 - g. Observe joints, fittings, and valves undergoing testing.
 - h. Remove and renew cracked pipes, joints, fittings, and valves that show visible leakage.
 - i. Retest.
 - j. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
 - k. Maintain pressure within plus or minus 5.0 psi of test pressure.
 - l. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of testing.
 - m. Compute maximum allowable leakage using following formula:
 - 1) $L = [SD \times \sqrt{P}]/C$.
 - 2) L = testing allowance, gph.
 - 3) S = length of pipe tested, feet.
 - 4) D = nominal diameter of pipe, inches.
 - 5) P = average test pressure during hydrostatic testing, psig.
 - 6) C = 148,000.
 - 7) If pipe undergoing testing contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each pipe size.
3. If testing of piping indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.
 4. Correct visible leaks regardless of quantity of leakage.

G. Manhole Testing:

1. Perform vacuum testing of all manholes. If air testing, test whenever possible prior to backfilling in order to more easily locate leaks.
2. Test manholes with manhole frame set in place.
3. Vacuum Testing:
 - a. Comply with ASTM C1244.
 - b. Plug pipe openings; securely brace plugs and pipe.
 - c. Inflate compression band to create seal between vacuum base and structure.
 - d. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10 in. Hg.
 - e. Close valve.
 - f. Manhole Test Duration in Seconds shall be a minimum of 75 or according to ASTM C1244 Table 1a whichever is longer.
 - g. Record vacuum drop during test period.
 - h. If vacuum drop is greater than 1 in. Hg during testing period, repair and retest manhole.
 - i. If vacuum drop of 1 in. Hg does not occur during test period, manhole is acceptable; discontinue testing.
 - j. If vacuum test fails to meet 1 in. Hg drop in specified time after repair, repair and retest manhole at no additional cost to the Owner.
 - 1) Repair both outside and inside of joint to ensure permanent seal.

H. Water Retaining Structure Testing

1. Exfiltration Testing:

- a. Exfiltration testing shall be performed prior to any specified backfill placement at the footing or wall.
- b. Plug pipes in manhole or structure excluding overflow.
- c. Remove water from manhole or structure.
- d. Observe plugs over period of not less than two hours to ensure that there is no leakage into manhole or structure.
- e. Fill manhole or structure with water within 4 inches of top of cover frame or overflow.
- f. Prior to testing, allow manhole to soak from minimum of four hours for manholes and 24 hours for other structures to maximum of 72 hours.
- g. Inspect the exterior of the wall and footing for damp spots. Damp spots shall be defined as spots where moisture can be picked up on a dry hand, the source of which is from inside the manhole or structure.
- h. After soak period, adjust water level inside the structure to within 4 inches of top of cover frame or overflow.
- i. Measure water level from top of manhole frame or access point.
- j. At end of the 24-hour testing period, again measure water level from the same point; compute drop in water level during testing period.
- k. The exfiltration test is considered satisfactory when drop in water level is less than 0.00947 gallons per foot diameter per foot of depth.

2. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.
3. Repair visible leaks regardless of quantity of leakage.

3.5 ATTACHMENTS

- A. Gravity sewer low pressure air test data sheet
- B. Manhole vacuum test data sheet
- C. Pressure Piping / Leakage Test

END OF SECTION 33 01 30.1
(FORMS FOLLOW)

GRAVITY SEWER LOW PRESSURE AIR TEST DATA SHEET

Owner (Name of city, district, etc.) _____ Test No. _____

Identification of Pipe Installation (Job name, location, contract number, etc.) _____

Field Test Data: (To be filled in by the Inspector)

Date: _____ Specified Maximum Pressure Drop _____psig

Identification of Pipe Material Installed_____

[illegible]

Inspector's Name and Title _____

Signature of Inspector: _____

MANHOLE VACUUM TEST DATA SHEET

Project Name: _____

Project Number: _____

Contractor / Foreman: _____

Owner: _____

[illegible]

Inspector's Name and Title _____

Signature of Inspector: _____

PRESSURE PIPING / LEAKAGE TEST

Project Name: _____

Project Number: _____

Contractor / Foreman: _____

Owner: _____

AWWAC600 Table 4.A Hydrostatic Testing Allowance per 1,000 ft of pipeline* -- gph

Avg. Test Pressure (psig)	Nominal Pipe Diameter (inches)																	
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
350	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07	6.83	7.58	8.09
300	0.35	0.47	0.7	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62	6.32	7.02	7.49
275	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38	6.05	6.72	7.17
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13	5.77	6.41	6.84
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86	5.47	6.08	6.49
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59	5.16	5.73	6.12
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29	4.83	5.36	5.72
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97	4.47	4.97	5.30
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63	4.08	4.53	4.83
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24	3.65	4.05	4.32

*If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

Date/Time of Test: _____

Start Time: _____ End Time: _____

Test Pressure: _____ psi. Test Length: _____ feet

Diameter (nominal): _____ inches

Allowable Leakage: _____ gal. Actual Leakage: _____ gal.

Result (Pass or Fail): _____

Comments: _____

I certify that I witnessed the referenced pressure and leakage test and that the documented results are satisfactory.

Inspector's Name and Title _____

Signature of Inspector: _____

MANDREL TEST

Project Name: _____

Project Number: _____

Contractor / Foreman: _____

Owner: _____

Material: _____

Maximum Allowed Deflection: _____

[illegible]

Witnessed / Inspector

[Inspector Name, Title]

SECTION 33 01 30.62 - MANHOLE GROUT SEALING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manhole interior cleaning.
2. Manhole sealing.

B. Related Requirements:

1. Section 33 01 30.61 - Sewer and Pipe Joint Sealing: Testing and sealing of sewer pipe joints.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C150 - Standard Specification for Portland Cement.

1.3 SCHEDULING

A. Schedule Work of this Section to coincide with joint sealing.

B. Furnish Work schedule when sewer piping section is out of service for joint sealing.

1.4 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit product data on grout or sealant.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements

D. Test and Evaluation Reports: Indicate vacuum and exfiltration testing results.

E. Manufacturer Instructions: Submit detailed instructions on application requirements, including storage and handling procedures.

F. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of sealed manholes.

1.7 QUALITY ASSURANCE

- A. Perform Work according to this specification and those referenced herein and/or federal, state, local, or other controlling regulations.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three (3) years documented experience.
- B. Contractor: Company specializing in performing Work of this Section with minimum three (3) years documented experience and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products per manufacturer.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Protect materials from damage by storing in secure location.

PART 2 - PRODUCTS

2.1 GROUT SEALANT

- A. Chemical Grout:
 1. Mixture of dry acrylamide and dry N, N-methylenebisacrylamide in proportions capable of diluting aqueous solutions and, when properly catalyzed, forming stiff gels.
 2. Make solution at concentrations as recommended by manufacturer.
 3. Able to tolerate ground water dilution and react in moving water.

4. Viscosity of less than 0.000041771 lbf-s/sq. ft., remaining constant until gelation concurs.
 5. Reaction time controllable from 10 seconds to 1 hour.
- B. Catalyst: Use ammonium persulfate in combination with activator; use of catalyst containing (dimethylamino) propionitrile is prohibited.
- C. Activator: Triethanolamine or other compounds of equivalent properties.
- D. Inhibitor: Potassium ferricyanide.
- E. Root Growth Inhibitor:
1. Dichlorobenzonitrile meeting recommendations of grout manufacturer.
 2. Root treatment additive capable of remaining active for minimum of two years.
 3. Active ingredient for destroying root intrusions: Sodium methyldithiocarbamate.
 4. Root Cell Inhibiting Agent:
 - a. 2,6-dichlorobenzonitrile.
 - b. For each application, disperse root control agent into clean, cool water free of acid, alkali, oxidizing agents, or large amounts of oil or other organic compounds or materials.
 - c. Use tanks for transportation or storage of makeup water free of material listed above.
- F. Portland Cement: ASTM C150, Type II.
- G. Fine Aggregate: ASTM C33 gradation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify which manholes require grouting.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Manhole Interior Cleaning:
1. Clean each defective or fouled manhole interior with high-velocity water jet to remove grease, dirt, sludge, and roots.
 2. Cut remaining roots flush with manhole interior.

3. Flush foreign material cleaned from interior of manhole; remove and properly dispose of material off Site.
4. If leaks are not readily identifiable upon completion of cleaning operation, use blower to dry manhole interior for positive identification of leaks and sweep areas.

3.3 APPLICATION

A. Grout Sealing:

1. Drill hole at each identifiable leakage point from inside manhole extending through sidewall of manhole.
2. Insert metal rod through hole to determine if exterior void space exists.
3. Fill exterior void spaces with chemical grout mix, pumping into void space until refusal is recorded by rise in pressure on pump pressure gauge.
4. Ensure that hole through manhole wall is kept open and free of chemical grout; plug hole and allow one hour for chemical grout to set.
5. Upon completion of grouting, pump manhole sealant until refusal at minimum pressure of 3.0 psig through probe-type injection equipment.
6. Deposit sealant from interior surface of set chemical grout through drilled hole to inside surface of manhole.
7. Upon setting of manhole sealant, remove excess material protruding into interior of manhole.

B. Testing:

1. Perform manhole testing per Section 33 01 30.13 - Sewer and Manhole Testing.

END OF SECTION 33 01 30.62

SECTION 33 05 13 - MANHOLES AND STRUCTURES

1.1 SUMMARY

A. Section Includes:

1. Modular precast concrete manholes, structures and accessories for sanitary sewer.
2. Masonry work as required for installation of manhole cover rings and inverts.
3. Doghouse manhole connections to existing sanitary sewer or storm sewer lines.
4. Bedding and cover materials.

B. Related Specification Sections:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 03 60 00 - Grouting
3. Section 31 23 16 – Excavation, Trenching & Backfill.
4. Section 33 01 30.13 - Sewer and Manhole Testing.
5. Section 33 31 00 - Sanitary Utility Sewerage Piping.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
2. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
3. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
4. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data for manhole covers, component construction, features, configuration, and dimensions.

C. Shop Drawings:

1. Indicate manhole or structure locations and elevations.
2. Indicate sizes, penetrations, angles, and elevations of piping covers and vents.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturers Test Reports: An original plus two copies of the following shall be submitted to the Engineer:

1. The name, address, and phone number of the product manufacturer and the location of the plant at which it was manufactured.
 2. Certification and certified test reports for each product (by number) of the tests performed on concrete and concrete cores showing the results of the tests.
- F. Design Data: Submit load calculations for buoyancy forces as required for Restrained Precast Manholes, data shall include the footing for restrained manholes.
- G. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- I. Qualifications Statements:
1. Submit qualifications for manufacturer and installer.
 2. Submit manufacturer's approval of installer.

1.4 QUALITY ASSURANCE

- A. Perform Work according to NPCA (National Precast Concrete Association) standards.
- B. Products shall be subject to inspection and approval at the factory, point of delivery, and after installation. The Owner may at his option inspect and photograph the manufacture of every product and the Contractor shall ensure that the manufacturer accommodates such inspection. The Engineer shall have the right to reject any product whose manufacture, in his sole opinion, is inconsistent with the Specifications and Drawings and to take independent samples of the materials being used at any time.
- C. Imperfections in and minor damage to the concrete may be repaired with epoxy mortar subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Epoxy mortar shall be used for repairs and shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days when tested in 3- x 6-inch cylinders stored in the standard manner. No repairs shall be made until the imperfections or damage has been inspected by the Engineer and repair authorized in writing. Repairs made prior to such authorization will be cause for rejection of the manhole component. Pieces proposed for repair at the factory shall be set aside for periodic inspection at the factory by the Engineer. Inspections will not be made more frequently than once per month. Rejected pieces shall not be shipped to or used for the work.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in shipping, handling and installation to avoid damaging the products. Any products damaged in shipment shall be replaced as directed by the Engineer.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
 - 1. Any precast concrete product showing a crack or damage or which has received a blow that may have caused an incipient fracture, even though such fracture is barely visible, shall be marked as rejected and removed from the work site. The Engineer's opinion on such observations and rejections shall be final.
 - 2. Precast concrete structures may be rejected for any of the following reasons:
 - a. Exposure of any reinforcement, wires, positioning spacers or chairs used to hold the reinforcement cage in position.
 - b. Reinforcing steel found to be in excess of 1/2 inch out of the specified position within cores.
 - c. Any shattering or flaking of concrete.
 - d. Voids which can be detected on the interior and exterior surfaces exceeding 1/4 inch in depth.
 - e. Unauthorized application of any repair or coating.
 - f. A deficiency greater than 1/4 inch from the specified wall thickness.
 - g. A variation from the specified internal diameter in excess of 1 percent.
 - h. Defects that indicate incorrect molding of concrete or any surface defect indicating honeycomb or other voids.
 - i. Any of the following cracks:
 - 1) A crack having a width of 0.005 inch to 0.01 inch throughout a continuous length of 36 inches or more.
 - 2) A crack having a width of 0.01 inch to 0.03 inch or more throughout a continuous length of 12 inches or more.
 - 3) Any crack greater than 0.005 inch extending through the wall and having a length in excess of the wall thickness.
 - 4) Any crack showing two visible lines of separation for a continuous length of 2 feet or more or an interrupted length of 3 feet or more anywhere in evidence both inside and outside.
 - 5) Any crack anywhere greater than 0.03 inch in width.
- C. Comply with precast concrete manufacturer's instructions **and ASTM C913** for unloading, storing, and moving precast manholes and drainage structures.
- D. Storage:
 - 1. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.
- E. In no event shall manhole building lag behind the pipe laying to the extent of more than two manholes.

PART 2 - PRODUCTS

2.1 MANHOLES AND STRUCTURES

A. Manufacturers:

1. Must be certified by the National Precast Concrete Association **NPCA** for production of precast concrete manholes and precast concrete structures.

B. Manhole and Structure Sections:

1. Description: Reinforced precast concrete conforming to ASTM C478 with gaskets conforming to ASTM C923.
 - a. Precast concrete manholes shall consist of precast reinforced concrete riser sections, a top section and a base section conforming to the typical manhole details as shown on the plans.
 - b. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the inside of each precast section.
2. Joints for Precast Manholes and Structures:
 - a. Joints between manhole sections shall be provided with a double joint sealant.
 - b. All joints shall be water tight using O ring rubber gaskets in accordance ASTM C443 and butyl mastic sealant in rope form.
3. Provide lifting hooks for top slab, where slab is required to be removed.

C. Mortar and Grout:

1. Mortar Shall be a 3:1 sand-cement (Type S) mix
2. Use Class A non-shrink grout per Section 03 60 00 for grouting ends of pipe into and out of the manhole

D. Reinforcement:

1. As specified by ASTM C478 for precast manholes and structures.

E. Construction:

1. The base, top slab, and vertical sections shall be cylindrical with tongue and groove joints.
2. Portland Cement: ASTM C 150 Type II or Type V and Blended Hydraulic Cement: ASTM C 595, Type IP (MS). Use one brand of cement throughout Project unless otherwise acceptable to ENGINEER.
3. Manhole bottom sections shall be precast by the manufacturer and shall be monolithically with the base section.

4. Sections shall be cured by an approved method of steam curing for at least 2 days and shall not be shipped until at least 5 days after steam curing.
 5. Concrete shall meet the requirements of ASTM C478. Any concrete with strength below 4,000 psi shall be rejected. Precast concrete shall be of the wet-cast process. Dry-cast processes shall not be acceptable.
 6. The minimum alkalinity of the finished concrete shall be 90 percent as a calcium carbonate equivalent. Documentation that the aggregates to be used in the manufacture of precast concrete manholes meet these requirements shall be submitted to the Engineer.
- F. Clear Inside Dimensions:
1. Diameter: as indicated on the plan drawings
- G. Design Depth:
1. As specified or shown on the plan drawings
- H. Clear Cover Opening Top Slab:
1. Diameter: 24 inches or as indicated on the drawings
 2. Top sections shall be shaped as an eccentric cone except where depth of manhole is not sufficient. Shallow manholes shall be provided with a flat slab top with entrance hole offset to one side over the steps.
- I. Invert:
1. All invert channels shall be smooth and semi-circular in shape, conforming to the inside of the adjacent sewer section.
 2. All inverts shall be constructed of Class B concrete or approved grouted polystyrene filler pieces. Brick and mortar inverts are not acceptable.
 3. Pipe openings shall provide clearance for pipe projecting a minimum of 2 inches inside the manhole.
 4. Invert troughs shall be formed and finished to provide a consistent slope through the manhole from the outlet to the inlets with a minimum 2.4 inch drop across the manhole unless shown or called out otherwise on the plan drawings. A ½ inch radius shall be provided at the intersection of 2 or more channels. Where future connections are to be provided, the inverts for them shall be constructed and one section of pipe of the proper size laid through the manhole wall and lightly plugged with a stopper and cement mortar.
 5. Invert troughs shall be half bench type. Benches shall have a float finish with a uniform slope toward the channel between 1 inch per foot and 2 inches per foot. A ¼ inch radius shall be provided at the edge of the bench and trough.
 6. Changes in direction of flow shall be made with a smooth curve of as large radius as the size of the manhole will permit.
 7. Drop connections shall be constructed as shown on the plans and consist of a "Memphis" tee, or tee with a spigot on the branch, drop pipe extending from the sewer to the invert of the manhole, and an elbow at the base. The drop connection shall be encased in concrete or in a brick box filled with sand.

- J. Pipe Entry: All manholes shall be provided with a flexible sleeve through which all pipe connections are made into the manhole. Each flexible sleeve shall consist of a high-quality synthetic rubber terminating in a flange cast into the manhole walls or by a compression joint made in the manhole wall. The flexible sleeves shall protrude out from the manhole and shall be of adequate size to accommodate the sewer pipe. After installation of the pipe within the sleeve, a watertight joint shall be made by securing the sleeve over the pipe with a stainless-steel strap, clamp, draw bolt and nuts. The flexible sleeves shall be as manufactured by Fernco, Joints, or approved equal. The banded boot connections shall be installed to provide compliance with ASTM C923. The couplings shall be tightened by use of a 60 in/lb. torque wrench.
- K. Steps:
1. Rungs/Safety Steps: Shall be 1/2 inch diameter grade 60 steel rod encased in copolymer polypropylene and withstand a load of 800 lbs and pull-out force of 400 lbs and meet OSHA requirements
 2. Formed integral with manhole sections
 3. Diameter: 1 inch or approved equal
 4. Width: Tread 16 inches and spaced at 15 inches on center vertically, set into manhole or structure

2.2 RINGS/FRAMES AND COVER

- A. Manhole cover and frame assembly shall be as specified herein
1. Frames and covers shall be grey iron casting meeting the requirements of ASTM A48 (latest revision), Class 30 iron. Casting shall be true, sharp, dense, and free of any blow holes, cracks, and other injurious defects.
 2. The cover shall be circular, have the words "SANITARY SEWER" cast on it, shall contain not more than two "pick" holes, and shall weigh not less than 120 pounds.
 3. The frames shall have a minimum inside opening of not less than 21 inches nor more than 24 inches, and shall weigh not less than 190 pounds. All bearing surfaces shall be machined. Frames and covers to be given two shop coats of bitumastic paint.
 4. Where indicated on the plans, watertight manhole covers shall be used to protect from inflow in areas affected by the fifty (50) year floodplain and street runoff.
- B. Manhole steps shall be manufactured from steel reinforced polypropylene plastic. All steps shall have non-skid top surfaces approximately 10 inches long and have stops at each end of the tread to help prevent a foot from slipping off. Minimum projection from wall shall be five inches.

2.3 RISER RINGS

- A. Riser Rings:
1. Thickness: 4 inches to 6 inches
 - a. Material: Precast concrete.
 - b. Comply with ASTM C478

2. Thickness: less than 4 inches
 - a. Material: Cast iron.
 - b. Comply with AASHTO M306.
3. Rubber Seal Wraps:
 - a. Wraps and Band Widths: Conform to ASTM C877 Type III.
 - b. Cone/Riser Ring Joint: Minimum 3 inches overlap.
 - c. Frame/Riser Ring Joint: 2 inches overlap.
 - d. Additional Bands: Overlap upper band by 2 inches

B. Accessories:

1. Joint Sealant: Comply with ASTM C990
2. Bolts:
 - a. Stainless Steel: Comply with ASTM F593.
 - b. Galvanized: Comply with ASTM F1554.

2.4 MANHOLE VENT PIPES

- A. Where indicated on the drawings, Manholes shall be provided with vent pipes as detailed on the Drawings.
- B. Vent pipes shall be fabricated from 5-inch Schedule 40 steel pipe. The upper end shall comprise two mitered pieces, butt welded all around as shown.
- C. The outside surface of the pipe shall be sand or grit blasted to commercial standard and coated with coal tar epoxy.
- D. All steel shall be Grade "B" with a minimum yield strength of 35,000 psi.
- E. The steel pipe shall have an inside coal tar lining 3/32..inch minimum thickness in accordance with AWWA C 203 or a coal tar epoxy lining 24-mils (dry) minimum dry film thickness (Koppers No. 300M, Americoat No. 78, Carboline-Carbomastic No. 14, or equal)

2.5 INFLOW DISH

- A. Where indicated on the drawings, manholes shall be fitted with manhole inserts
- B. Manhole inserts are to be manufactured of high-density hexane-1 copolymer meeting ASTM D1248, Class A, Category 5.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and are ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.
- D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.
- E. Manhole barrels shall have properly sized and located pipe openings. Field cutting of openings will be allowed only by specific Engineer approval. Contractor shall determine the location of all vent pipe openings prior to manufacturing the manholes so that openings are correct.

3.3 INSTALLATION

- A. General:
 - 1. The excavation shall be sufficiently large to permit the construction to be performed in a workmanlike manner, and in no event shall manhole building lag behind the pipe laying to the extent of more than two manholes.
 - 2. Provide clearance around sidewalls of manhole or structure for construction operations
 - 3. If groundwater is encountered, provide dewatering procedures/measures as necessary for installation of manhole or structure in a compacted excavation not holding water. Place geotextile fabric and stone as required.
 - 4. The Contractor shall protect the structure against the inflow of surface water and against flotation until the structure is accepted.
 - 5. Install manholes and structures supported at proper grade and alignment on crushed stone bedding of the thickness shown on the Drawings. Immediately after setting the manhole base and first barrel section, stone bedding shall be installed to 6" above the top of the pipe.

6. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides and compacting as specified in Section 31 23 16.13.

B. Precast Concrete Manholes and Structures:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes or structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Set precast structures, bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 16.13 - Fill or on other support system as indicated on the plan drawings.
4. Concrete bases and barrel sections shall be set so as to be vertical and with sections in alignment with a plus or minus 2-degrees maximum tolerance.
5. Assembly:
 - a. Assemble multi-section manholes and structures by lowering each section into excavation.
 - b. Install rubber gasket and butyl sealant rope in the joints between precast sections.
 - c. Lower, set level, and firmly position base section before placing additional sections.
6. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
7. Verify that installed manholes **or** structures meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with non-shrink grout using hydraulic cement.
9. Where additional holes may be cut in the precast sections to accommodate pipes, cutting shall be done only by drill and saw or coring device. Breaking by any type of hammer device shall not be allowed.

C. Doghouse Manholes and Structures:

1. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
3. Protect existing pipe from damage.
4. Remove unsuitable material as necessary and replace with granular fill compacted to **95** percent maximum density, compaction shall be 100% maximum dry density if manhole is located in a paved roadway.
5. Prepare crushed stone bedding or other support system, as indicated on Drawings, to receive foundation slab as specified for precast manholes and structures.
6. Install doghouse manhole or structure around existing pipe according to applicable Paragraphs in this Section.
7. Grout pipe entrances as specified in this Section.
8. Build invert by grouting base of manhole or structure to achieve a sloped bench to top edge of pipe and trowel smooth.

D. Sanitary Manhole Drop Connections:

1. Construct drop connections into sanitary manholes as indicated on Drawings and specified herein.

E. Castings:

1. Set frames using mortar and masonry and/or as indicated on **the drawings**.
2. Lay concrete brick in full bed of mortar and completely fill joints.
3. If more than one course of concrete brick is required, stagger vertical joints.
4. Set frame and cover to the grade or elevation as shown or called for on the plan drawings.

F. Manhole Linings

1. Where indicated on the drawings concrete manholes shall be lined as specified in Section 09 80 10

3.4 FIELD QUALITY CONTROL

- A. Test concrete manhole and structure sections as specified in Section 33 01 30.13 - Sewer and Manhole Testing.
- B. Contractor shall replace any work damaged after installation as a result of their construction activities.
- C. Vertical Adjustment of Existing Manholes and Structures:
 1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
 2. Frames, Grates, and Covers:
 - a. Carefully remove frames, grates, and covers cleaned of mortar fragments.
 - b. Reset to required elevation according to requirements specified for installation of castings.
- D. Manholes shall be thoroughly cleaned of all silt, debris, and foreign matter of any kind prior to final inspection by the Engineer.

END OF SECTION 33 05 13

SECTION 33 05 16.13 - PRECAST CONCRETE UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete utility structures.
2. Drainage system catch basins.
3. Drainage system inlets.
4. Pipe Headwalls.
5. Pipe Flare End Section
6. Frames and covers.
7. Access hatches.

B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Division 31 – Earthwork
3. Division 33 – Utilities

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO HB-17 - Standard Specifications for Highway Bridges.
2. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

B. American Concrete Institute:

1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
2. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

C. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A48 - Standard Specification for Gray Iron Castings.
3. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
4. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

5. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
6. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
7. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
8. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
9. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
10. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
11. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
13. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
14. ASTM C33 - Standard Specification for Concrete Aggregates.
15. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
16. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
17. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
18. ASTM C150 - Standard Specification for Portland Cement.
19. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
20. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
21. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
22. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
23. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
25. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
26. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
27. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
28. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
29. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
30. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
31. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
32. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

33. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
34. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
35. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
36. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
37. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
38. ASTM C1433 - Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
39. ASTM C1504 - Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforced Steel.

E. National Precast Concrete Association:

1. NPCA Plant Certification Program.
2. NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data for frames and covers, steps, component construction, features, configuration, and dimensions.

C. Shop Drawings:

1. Indicate structure locations, elevations, sections, equipment supports, piping, conduit, sizes and elevations of penetrations, and block-outs/knockouts.
2. Indicate design, construction and installation details, typical reinforcement and additional reinforcement at openings.

D. Submit concrete mix design for each different mix.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for custom fabrications.

G. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Qualifications Statements:

1. Submit qualifications for manufacturer.

1.4 QUALITY ASSURANCE

A. Obtain precast concrete utility structures from single source.

B. Perform structural design according to ACI 318.

C. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

D. Conform to following material and fabrication requirements:

1. Single Cell Box Culverts: ASTM C1433.

2. Other Structures: ASTM C913.

E. Perform welding according to following:

1. Structural Steel: AWS D1.1.

2. Reinforcing Steel: AWS D1.4

F. Perform Work according to National Precast Concrete Association (NPCA) standards.

G. Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete. Drawings shall bear the stamp of the P.E.

1.5 QUALIFICATIONS

A. Manufacturer: Certified by NPCA Plant Certification Program prior to and during Work of this Section.

B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

C. Welders and Welding Procedures: AWS qualified within previous 12 months for employed weld types.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Do not deliver products until concrete has cured **5** days or has attained minimum **75** percent of specified 28-day compressive strength.

- C. Inspection: Accept precast structures on Site in manufacturer's original packaging and inspect for damage.
- D. Comply with precast concrete manufacturer instructions for unloading, storing, and moving precast structures.
- E. Lift structures from designated lifting points.
- F. Storage:
 - 1. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Design structures for minimum loads conforming to ASTM C857 and ASTM C890.
- B. Roof Live Load: Comply with following loading conditions, including impact load:
 - 1. Heavy Traffic:
 - a. ASTM C857, A-16.
 - b. Maximum 16,000 lb. each wheel.
 - 2. Medium Traffic:
 - a. ASTM C857, A-12.
 - b. Maximum 12,000 lb. each wheel.
 - 3. Light Traffic:
 - a. ASTM C857, A-8.
 - b. Maximum 8,000 lb. each wheel.
 - 4. Walkway Traffic:
 - a. ASTM C857, A-0.3.
 - b. Maximum 300 psf.

2.2 PRECAST CONCRETE UTILITY STRUCTURES

- A. Manufacturers:
 - 1. Armorcast Products Company
 - 2. Hanson Pipe and Precast

3. Manarch Products, Inc.
4. Old Castle Precast, Inc.
5. Or Approved Equal

B. Precast Concrete Utility Structures: Reinforced precast concrete.

1. As shown on the Drawings

2.3 FRAMES AND COVERS

A. Manufacturers:

1. Barry Pattern & Foundry Company
2. EJ Iron Works
3. Neenah Foundry, U.S. Foundry, Castings Inc.
4. McKinley Iron Works, Inc.
5. Or Approved Equal

B. Description:

1. Construction: ASTM A48, Class 30B cast iron or other material as shown on the plan drawings.
2. Frame for cover: Shall be cast in place by the precast concrete manufacture or blocked-out for field installation of frame per dimensions required for the opening.

2.4 ACCESS HATCHES

A. Manufacturers:

1. The Bilco Company.
2. U.S.F. Fabrication.
3. Halliday Products.
4. Or Approved Equal.

B. Access Hatch:

1. All access hatches shall be double or single leaf as shown on the drawings. Automatic doors shall be equipped with a minimum of two stainless steel hinges with stainless steel pins. Each door leaf shall also have spring operators with a positive hold open arm that engages automatically in full open position, and a non-corrosive release handle. Doors shall open with a maximum lift force of 9 lbs. When closed, doors shall not protrude above the operating surface in which they are installed. Include slam lock feature with removable key.
2. When subject to vehicular traffic, cover shall be reinforced to support an AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span.
3. Door leaves shall be 1/4-inch aluminum checkered plate reinforced with structural aluminum channels, capable of withstanding 300 pounds per square foot uniform load

with minimal deflection for non-vehicular loading service. When subject to vehicular traffic, cover shall be reinforced to support an AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span.

4. The gutter frame provided shall be of 1/4-inch aluminum with an anchor flange around the perimeter. Frame shall incorporate a 1 1/2" threaded drain fitting and neoprene gasket.
5. The drain coupling shall be located in an appropriate corner of each channel frame away from the access steps. Contractor shall attach and route Sch 80 PVC pipe from drain port to daylight away from structure. If daylight is not readily accessible within 10-ft, then contractor shall terminate piping into 1/2 cubic yard of #57 stone wrapped with filter fabric. Piping shall project through walls with sleeve and Link-Seal in a water-tight (leak-proof) installation.
6. Factory finish shall be mill finish.
7. Hardware shall be stainless steel.
8. Any surface or portion of the frame contacting concrete shall receive a bituminous coating.
9. The door shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand.
10. Doors, which are to receive flooring, shall be smooth plate. Doors which will not receive flooring shall be checkered plate

2.5 MATERIALS

- A. Concrete: As specified in Section 03 30 00 – Cast-In-Place Concrete.
- B. Admixtures: As specified in Section 03 30 00 – Cast-In-Place Concrete.
- C. Concrete Reinforcement: As specified in Section 03 30 00 – Cast-In-Place Concrete.

2.6 FABRICATION

- A. Fabricate precast concrete utility structures conforming to ACI 318 and NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- B. Fabricate precast concrete utility structures with knock-out panels, embedded items (frames, etc.), and openings to size and configuration as indicated on Drawings.
- C. Construct forms to provide uniform precast concrete units with consistent dimensions.
- D. Clean forms after each use.

E. Reinforcing:

1. Install reinforcement by tying or welding to form rigid assemblies.
2. Position reinforcement to maintain minimum ½ inch cover.
3. Secure reinforcement to prevent displacement while placing concrete.

F. Position and secure embedded items to prevent displacement while placing concrete.

G. Deposit concrete in forms and consolidate concrete without segregating aggregate.

H. Provide initial curing by retaining moisture using one of following methods:

1. Cover with polyethylene sheets.
2. Cover with burlap or other absorptive material and keep continually moist.
3. Apply curing compound according to manufacturer instructions.

I. Provide final curing according to manufacturer's standard.

J. Remove forms without damaging concrete.

K. Tension reinforcement tendons as required to achieve design load criteria.

L. Exposed Ends at Stressing Tendons: Fill recess with non-shrink grout, trowel flush.

2.7 MIXES

A. Concrete:

1. Design Mix shall be as specified in Section 03 30 00 – Cast-In-Place Concrete.

2.8 FINISHES

A. Reinforcing Steel, Wire and Wire Fabric, Concrete and Steel shall be as specified in Section 03 30 00 – Cast-In-Place Concrete.

2.9 ACCESSORIES

A. Membrane Curing Compound: ASTM C309, Type 2, Class A.

B. Steps:

1. Formed steel-reinforced polypropylene rungs.
2. Diameter: 3/4 inch.
3. Width: 10 inches, minimum.
4. Spacing: 15 inches o.c. vertically or as indicated on Drawings.

C. Inserted and Embedded Items:

1. Structural Steel Sections:
 - a. Comply with ASTM A36.
 - b. Finish: As shown or called for on the plans or in related specification sections
- D. Bearing Pads:
 1. High density plastic, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene), or Tetrafluoroethylene (TFE); Shore A Durometer; 1/8 inch (3 mm) thick, smooth both sides.
- E. Joint Sealants and Joint Gaskets:
 1. Gasket Joints for Circular Concrete Pipe:
 - a. ASTM C443.
 - b. Gaskets: Oil-resistant rubber.
 2. External Sealing Bands:
 - a. Comply with ASTM C877.
 - b. Material: Type I, rubber and mastic.
 3. Preformed Joint Sealants for Concrete Pipe and Box Sections: Comply with ASTM C990
 4. Elastomeric Joint Sealants:
 - a. Comply with ASTM C920.
 - b. Material: Polyurethane.
 - c. Grade NS, Class 35.
- F. Pipe Entry Connectors: Comply with ASTM C923.
- G. Grout:
 1. Cement Grout: Portland cement, sand, and water mixture with stiff consistency to suit intended purpose.
 2. Non-Shrink Grout:
 - a. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
 - b. Conform to ASTM C1107.
 - c. Minimum Compressive Strength: 2,400 psi in 48 hours, and 7,000 psi in 28 days.
- H. Bituminous Coating:
 1. Manufacturers:
 - a. Carboline Company; a subsidiary of RPM International
 - b. Duron, Inc.
 - c. Laurence, C.R. Co., Inc.
 - d. Or Approved Equal

2. Description: Provide damproofing on the exterior side of structures in the field where structure will be below grade. Coating shall be a two-component, self-priming, chemically cured, coal tar epoxy protective coating.

I. Touch-Up Primer for Galvanized Surfaces:

1. As specified in Section 09 96 00 – High-Performance Coatings

2.10 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

1. Perform following tests for each 100 cu. yd. of concrete placed with minimum one set of tests each week:
 - a. Slump: Comply with ASTM C143.
 - b. Compressive Strength: ASTM C31 and ASTM C39.
 - c. Air Content: Comply with ASTM C231 or ASTM C173.
 - d. Unit Weight: Comply with ASTM C138.
2. Make test results available to Engineer/Owner upon request.

C. Inspection:

1. Visually inspect completed precast structures for defects.
2. Repair defects on surfaces exposed to view to achieve uniform appearance.
3. Repair honeycomb by removing loose material and applying grout to produce smooth surface flush with adjacent surface.
4. Repair of major defects not allowed

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are properly sized and located.
- C. Verify correct size and elevation of excavation.
- D. Verify that subgrade and bedding are properly prepared, compacted, and ready to receive Work of this Section.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Mark each precast structure by indentation or using waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.
- C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- D. Do not install structures if Site conditions induce loads exceeding weight capacity of structures.
- E. Inspect precast concrete structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

- A. Install underground precast utility structures according to ASTM C891.
- B. Lift precast concrete structures at lifting points designated by manufacturer.
- C. When lowering structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
- D. Install precast concrete base to elevation and alignment as indicated on Drawings.
- E. Install precast concrete utility structures to elevation and alignment as indicated on Drawings.
- F. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members
- G. Maintain temporary bracing in place until final support is provided. Protect members from staining
- H. Provide temporary lateral support to prevent bowing, twisting, or warping of members
- I. Adjust differential camber between precast members to tolerance before final attachment
- J. Install bearing pads
- K. Level differential elevation of adjoining horizontal members with grout to maximum slope of 1:12
- L. Assembly of Multi-section Structures:
 - 1. Lower each section into excavation.
 - 2. Clean joint surfaces.

3. Install watertight joint seals according to manufacturer instructions using gasket joints, external sealing bands, preformed joint sealants, elastomeric joint sealants, grout, as required.
- M. Remove knockouts or cut structure to receive piping without creating openings larger than required to fit pipe; fill annular space with grout.
- N. Pipe Connections:
 1. Connect pipe to structure and seal watertight.
 2. Cut pipe flush with interior of structure.
- O. Base/Foundation slab:
 1. Grout to achieve slope to exit piping.
 2. Trowel smooth.
 3. Contour to form continuous drainage channel as indicated on Drawings.
- P. Paint exterior with two coats of bituminous interior coating at rate of per coating manufacturer for each coat.
- Q. Frame and Cover and Access Hatch:
 1. Set level, without tipping, to elevations as indicated on Drawings.
 2. Set cover and access hatch 3 inches above finished grade for structures located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
 3. Connect drain from access hatch frame to storm drainage system.
- R. Touch up damaged galvanized coatings.
- S. Backfill excavations for structures as specified in Division 31.

3.4 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances
- B. Conform to PCI MNL-116S.
- C. Design and erect to the following tolerances:
 1. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch/10 feet and 3/8 inch in 100 feet, non-cumulative.
 2. Maximum Offset from True Alignment between Members: 1/4 inch.
 3. Maximum Variation from Dimensions Indicated on Reviewed Shop Drawings: Plus or minus 1/8 inch.
- D. Exposed Joint Dimension: 3/8 inch plus or minus 1/4 inch.

- E. When members cannot be adjusted to conform to design or tolerance criteria, cease work and advise. Execute modifications as directed

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Perform vacuum test and exfiltration test as specified in Division 33.

END OF SECTION 33 05 16.13

SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PVC Pipe
2. Ductile Iron Pipe
3. Ductile Iron Fittings
4. Concrete Pipe
5. HDPE Pipe
6. HDPE Fittings
7. Accessories

B. Standards

1. Standards: Supply all products and perform all work in accordance with applicable American Society of Testing and Material (ASTM), American Water Works Associations (AWWA), American National Standards Institute (ANSI), or other recognized standards.
2. Latest revisions of all standards are applicable.

C. Related Sections

1. Division 01 Specifications
2. 33 01 30.13 Sewer and Manhole Testing
3. 33 05 13 Manholes and Structures

1.2 SUBMITTALS

- A. Product Data: Manufacturer information indicating pipe material to be used, and pipe accessories.
- B. Manufacturer's Certificate: Products meet or exceed specified requirements.
- C. Certified mill certificate showing conformance to all requirements specified herein.
- D. Manufacturer Instructions: Special procedures required to install specified products.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. General arrangement and dimensional drawings.
- G. Laboratory Approval – Ductile Iron Pipe shall be tested by an independent laboratory, approved by the Engineer, in accordance with AWWA C151.

1.3 QUALITY ASSURANCE

- A. Perform Work according to applicable SCDHEC, OSHA, AWWA, and ASTM standards.
- B. All pipes shall be first quality, with smooth interior and exterior surfaces, free from cracks, blisters, "honeycombs," and other imperfections, and true theoretical shapes and forms throughout the full length.
- C. All pipes shall be subject to the inspection of the Engineer at the pipe plant, trench, or other points of delivery, for the purpose of culling and rejecting pipe, independent of the laboratory test which does not conform to the requirements of these specifications. Such pipe shall be marked by the Engineer, and the Contractor shall remove it from the project site upon notice of its rejection being received.

PART 2 - PRODUCTS

2.1 PVC PIPE

A. General

- 1. All PVC pipe and fittings shall be clearly marked as to size, ASTM, Company, SDR or DR, and date of manufacture. No pipe shall be accepted that is more than 120 days old when delivered to the job site.
- 2. Pipe shall be manufactured of PVC having a cell classification of 12454 or 12364 as defined in ASTM D 1784. Additives and fillers including but not limited to stabilizers, antioxidants, lubricants, colorants, etc. shall not exceed 10 parts by weight per 100 parts of PVC resin in the compound.
- 3. A certified mill certificate showing conformance to all requirements specified above shall be provided to the Engineer with each shipment of pipe delivered to the job site.
- 4. All PVC pipe shall be green in color and stenciled "SANITARY SEWER."
- 5. PVC pipe shall not be used in locations where the pipe has a cover less than four feet, where crossing creek or ravine bottoms where the pipe may be exposed, or where sewers are laid under railroads, powerline easements, or roadway rights of way.

B. PVC Pipe for Gravity Sewers

- 1. PVC pipe for gravity sewers shall be manufactured in accordance with ASTM D 3034 for 4" through 15" SDR 35 minimum and F679 for 18" through 36" 46PS/115PS sewer pipe as indicated on the drawings.
- 2. Joints shall be of the rubber gasket slip on type conforming to ASTM D 3212 under both pressure and vacuum. The bell shall be an integral part of the pipe with the same strength. Spigot ends shall be beveled.
- 3. Elastomeric gaskets shall meet the requirements of ASTM F477. Gaskets shall be locked in, NAPCO, HARCO, or approved equal.
- 4. PVC pipe material at different depth of burial, as defined from the final ground surface to the bottom of the pipe, shall conform to the following schedule:
 - a. 4' to 15' SDR 35 with a minimum pipe stiffness of 46 PSI
 - b. 15' to 22' SDR 26 with a minimum pipe stiffness of 115PSI
 - c. > 22' use Ductile Iron or other alternate material, as directed by the Engineer.

5. Transitions from PVC pipe to Ductile Iron pipe shall be made only at manholes.

C. PVC Pipe for Low Pressure Sewer

1. PVC pipe for force mains shall conform to the requirements of AWWA C900. Pipe shall be green in color and marked with the nominal pipe size, PVC dimension ratio, AWWA pressure class, AWWA designation number (AWWA C900), manufacturer's name and labeled "Sewer Force Main".
2. The pressure rating shall be selected based upon the design requirements of the system. The minimum wall thickness shall be DR 18, Class 150.
3. Pipe shall be Type I, Grade I and shall be manufactured from clear virgin material.
4. All gaskets shall meet ASTM F477 standards.
5. PVC joints shall be restrained where specified on the drawings.
 - a. Restrained joints shall be provided by a clamping ring and an additional ring designed to seat on the bell end of the pipe. The rings shall be connected with T-Head bolts or rods.
 - b. Restraining devices shall provide full (360°) support around the circumference of the pipe. No point loading shall be permitted. Restraint of mechanical joint fittings shall be provided by a clamping ring installed on the PVC pipe and connected to the mechanical joint fitting with T-Head bolts or rods.
 - c. Restraining devices shall meet or exceed the requirements of UNI-Bell B-13 "Recommended Standard Performance Specification for Joint Restrainers for Use with PVC Pipe." Restraining devices shall be Uni-Flange Series 1300 or 1350 or approved equal.

2.2 DUCTILE-IRON PIPE:

- A. Where ductile iron pipe is specified for use in the construction of gravity sewers or force main, it shall be Pressure Class 350 ductile iron manufactured in accordance with requirements of AWWA C151/A21.51 complete with a cement mortar lining per AWWA C104, unless otherwise specified.
- B. Pipe laying lengths shall be provided in 18- or 20-foot nominal lengths with allowable trim pipe lengths in accordance with AWWA C151 and special shorter lengths provided as required by the Drawings.
- C. All ductile iron pipes and fittings, installed in a trench conditions shall receive a shop-applied bituminous coating 1-mil thick, minimum in accordance with AWWA C151/ANSI A21.51.
- D. All exposed pipe and fittings shall be provided with a shop prime and painted as specified.
- E. Where flexible joint iron pipe is called for on the plans, it shall conform to the same specifications as ductile iron. The joints shall be of the ball and socket type either bolted or keyed and, if of the bolted type, the bolts and nuts shall be made of stainless steel. The trench in which this pipe is installed shall be excavated to a depth that will provide a cover of not less than 3' over the top of the pipe when it is in place.

- F. All ductile iron sewer main pipes shall be color coded green by painting a 3" green stripe along the crown of the pipe barrel.
- G. Push-on joints
 - 1. Where push-on joint ductile iron pipe is called out on the Drawings, the push-on joints shall conform to AWWA C111.
 - 2. Push-on joints shall be Fastite, as manufactured by American Ductile Iron Pipe, Tyton as manufactured by US Pipe, or pre-approved equal. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less.
- H. Restrained Joint Pipe
 - 1. Where Restrained Joint Ductile Iron Force Main is called out on the Drawings, the restraining devices shall be Megalug 1100 series or approved equals.
 - 2. Where Restrained Joint Ductile Iron Force Main w/ Grip Lock Gaskets is called out on the plans, the restraining devices shall be US Pipe Field Lok 350, American Fast-Grip, McWane Ductile TR Flex, or approved equal.
- I. Flanged Joint Pipe
 - 1. Where flanged joint ductile iron pipe is called out on the Drawings, the pipe shall conform to AWWA C115 with gaskets and bolts conforming to AWWA C115 Appendix A.
 - 2. Bolt circle and bolt holes match those of ANSI B16.1 class 125 and ANSE B16.5 class 150 flanges. The flanges shall be rated for at least 250 psi working pressure.
 - 3. Bolts and nuts shall be type 316 stainless steel, conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
 - 4. Gaskets shall be full faced specially designed for a working pressure greater than 250 psi and shall be Toruseal as manufactured by American, US Pipe Flange-Tyte , or approved equal.

2.3 DUCTILE-IRON FITTINGS

- A. Ductile iron fittings shall be provided in locations as shown on the plans or in locations deemed necessary by the Engineer. Ductile iron fittings 12" and smaller shall be rated for 350 psi working pressure and fittings larger than 12" shall be rated for 250 psi working pressure.
- B. Fittings shall be manufactured in accordance with AWWA C153 and provided with mechanical joints. All fittings shall be provided with a thin cement lining in accordance with AWWA C104.
- C. Use Tee-head or non-hex head bolts and hex head nuts for joint makeup and gasket seating, bolts and nuts shall be carbon steel coated with corrosion inhibiting fluoropolymer composite material. Mechanical joint fittings shall be furnished with sufficient quantities of accessories as required for each joint. All mechanical joints shall be restrained.
- D. Ductile Iron fittings with retainer glands shall be provided.
- E. All fittings shall be wrapped in 6 mil polyethylene encasement extending 6" beyond the connection in accordance with AWWA C105.

- F. Concrete thrust block/restraints shall be 2500 psi concrete poured in place against undisturbed soil at each fitting location.
- G. Where 90 degree deflections occur along the route of the force main, two (2) 45 degree bends shall be used where possible.

2.4 REINFORCED CONCRETE PIPE:

- A. Reinforced concrete pipe shall conform to ASTM C76, latest revision and as specified herein. Cement for the pipe shall conform to ASTM C150 Type II or I, except that tricalcium aluminate shall not exceed 8%. A minimum of 7.5 bags of cement shall be used for each cubic yard of concrete. Fine and coarse aggregate shall conform to ASTM C33, and the coarse aggregate shall be made from 100 percent limestone. Manufacturer's mill certificates of chemical composition and mix shall be provided to verify that these requirements are met. The concrete alkalinity shall be a minimum 0.70 equivalent CaCO_3 or above. Inspection and rejection Sections 15 and 16 of the ASTM C76 shall apply, except that inspection shall be at the Contractor's expense. Basis of acceptance of the pipe shall be in accordance with 5.1.1 of ASTM C76.
- B. Reinforced concrete pipe for cuts in excess of 12 feet shall meet the requirements for design strength of ASTM C76, Class IV, with wall thicknesses B or C. All designs shall be approved by physical test of sample pipe at the manufacturer's expense. Reinforced concrete pipe for cuts of 12 feet or less shall meet the requirements for design strength of ASTM C76, Class III, with wall thicknesses B or C.
- C. The placement of reinforcement in 24" and larger diameter pipe shall be such that the circumferential reinforcement is not closer than 1 1/2" to the inside surface of the pipe.
- D. All testing as specified herein shall be performed by a commercial testing laboratory as approved by the engineer with work being done at the contractor's expense.
- E. Pipe bedding shall be Class C as shown on the drawings and as shown in the Concrete Pipe Design Manual, latest edition.
- F. Concrete pipe shall be furnished with joints of the round rubber gasket type using bell and spigot design meeting ASTM C443, latest revision. Absorption of the concrete pipe shall not exceed 6% of the dry weight.
- G. Concrete pipe shall be lined if indicated on the drawings.

2.5 POLYETHYLENE PIPE

- A. All polyethylene pipe and fittings shall be molded from Virgin PE4710 HDPE resins in accordance with the requirements of ASTM D3035 and manufactured to comply with ASTM F714.
- B. Unless otherwise specified, the nominal size and DR shall be as shown on the Drawings. HDPE fittings shall be fully pressure rated.

- C. GRAVITY SEWER - Profile wall polyethylene pipe and fittings for gravity sewers shall be of the spiral wound type. The pipe shall be made of high density, high molecular weight polyethylene pipe material meeting the requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D-1248. The pipe shall be provided with rubber gasket joints that meet the non-pressure requirements of ASTM F477. Special heavy wall pipe sections having a smooth outside wall shall be supplied for all manholes and connections to other types of pipe.
- D. PRESSURE MAINS – HDPE pipe and fittings shall have a nominal IPS (iron pipe size) outside diameter per ASTM F714. Pipe sections shall be joined on the job site above ground into continuous length by the butt-fusion method in accordance with ASTM F2620, and be performed in strict accordance with the manufacturer's recommendations. Butt-fusion fittings shall comply with ASTM D3261.
- E. HDPE pipe shall be joined to ductile iron valves and fitting with a DIPS size MJ adapter kit. Pipe stiffeners shall be used to maintain roundness of the pipe. MJ adapter and stiffeners shall be installed in strict accordance with the manufacturer's recommendations.
- F. Pipe shall be supplied in lengths not less than 40 feet long, of the size and wall thickness as shown on the plans. The combined soil pipe system shall be reviewed and approved by the pipe manufacturer to ensure an installation limiting maximum deflection of the pipe to less than five percent of base diameter, when both soil and maximum water loads are applied. The pipe shall be handled and installed in strict accordance with the recommendations of the manufacturer.

2.6 ACCESSORIES

- A. Polywrap: Where indicated on the drawings ductile iron pipe shall be wrapped in 6 mil polyethylene encasement in accordance with AWWA C105. All fittings shall be wrapped in 6 mil polyethylene encasement extending 6" beyond the connection.
- B. Zinc Coating: Where indicated on the drawings, ductile iron pipe for buried service shall be coated with a layer of arc-sprayed zinc. The mass of the zinc applied shall be 200 g/m² of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils.
 - 1. The zinc coating system shall conform to ISO 8179 standard.
 - 2. All pipe shall be manufactured and zinc coated in the United States at the pipe manufacturer's facility.
- C. Protective Lining: The Contractor shall provide interior protective lining where indicated on the drawings or specified below.
 - 1. Ductile iron pipe and fittings shall receive an epoxy lining of the interior surface where indicated on the drawings. The interior protective liner shall be an amine cured novolac epoxy applied to a dry film thickness of 40 mils minimum, and shall be Protecto 401™ Ceramic Epoxy or approved equal. Ductile iron pipe to be lined shall not be cement mortar lined. Epoxy linings shall be inspected for holidays using an electrical detector.
 - 2. T-LOCK liner shall be supplied for concrete pipe when indicated on the drawings. The liner shall be constructed of a combination of PVC resin, pigments and plasticizers compounded as manufactured by Ameron Protective Coatings, Western Environmental,

or approved equal. The liner shall have a thickness of 0.065 inches with a coverage of not less than 270 degrees. Tee shaped locking extensions of the same material as the liner shall be integrally extruded with the sheet. The extensions shall be 2.5 inches apart and 0.375 inches high. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the pipe. The concrete pipe shall be poured against the liner material in strict accordance with the manufacturer, the integrity of the liner shall be tested prior to shipment, and any pinholes located shall be repaired and retested. No pipe with damaged lining will be installed or accepted until and unless the damage has been repaired to the satisfaction of the engineer. Field joints using mortar and joint flaps mating with the locking extensions shall be carefully installed as recommended by the manufacturer.

D. Pipe weights

1. Unless otherwise noted in the Specifications, all gravity sewer pipe installed with less than three diameters of cover over the top of the pipe barrel shall be provided with concrete weights to prevent flotation.
2. The weights shall be spaced at ten feet centers, with each weight weighing not less than 800 pounds. The weights may be constructed of a cast iron bolt on design, or they may be of the concrete cast in place type for below ground installations. Cast in place weights shall each contain two No. 3 rebars bent over and around the pipe barrel to provide adequate tensile strength to the upper part of the weight. Above ground portions of concrete weights shall be neatly formed and rubbed upon completion of the work.

E. Air Vacuum Valves

1. Where air vacuum valves are specified for installation on sewage force mains, the price bid shall include a standard manhole six feet deep constructed over the force main and a valve assembly constructed in accordance with the following specifications.
2. All air release and vacuum valves shall be sized per the manufacturer and approved by the engineer prior to installation based on the owner's preferences and the anticipated line pressures.
3. Sewage air and vacuum valves shall permit unrestricted passage of air during filling of the force main. The valve body shall be stainless steel with stainless steel screws, unless indicated (stainless steel) in the plan set. The float and all internal metal parts shall be stainless steel, and the valve shall be designed so that the venting mechanism does not come into contact with sewage. The air and vacuum combination valves for sewage shall be ARI Model D-020 or equal. The valve shall have a NPT inlet sized by the manufacturer and shall be fitted with a back flushing device.
4. The air release valve shall be connected to the force main by a threaded connection on the top of the force main and, if necessary, a tapped tee shall be used for this connection. Between the main connection and the air release valve a shut off valve matching the size of the valve and 1" blow off valve shall be furnished and installed.
5. Contractor is responsible for providing an odor control device for each Combination Air Release/Vacuum Valve.
6. Manufacturers:
 - a. APCO, Schaumburg, IL.
 - b. ARI Flow Control Accessories
 - c. Or Approved Equal

F. Tracer Wire

1. Insulated copper wire shall be installed on all non-metallic pipe force mains. The wire shall be 10 gauge stranded type TW copper marker wire with electronically continuous joints with blue or purple thermoplastic insulation recommended for direct burial. The marker wire shall be brought up to laterals at right of way clean outs and valve boxes so as to be readily accessible to system operators. All wire connections and splices shall be tied and tightly taped with insulated electrical tape. All costs associated with the installation of the marker wire shall be included in the price bid for the pipe.
2. Detection Tape
 - a. Green metallic detection tape shall be provided for all PVC pipes.
 - b. Detection tape shall be composed of a solid aluminum foil encased in a protective plastic jacket. Tape shall be marked "CAUTION SEWER MAIN BURIED BELOW."
 - c. Tape shall be permanently printed with no surface printing allowed. Tape width shall be a minimum of 3-inches and have a minimum thickness of 5 mil.
 - d. Tape shall be marked "CAUTION SEWER MAIN BURIED BELOW."
 - e. All tracer wire termination points will use a test station. Test stations shall be Lite Duty Snakepit test station (LD14*TP) green in color, as manufactured by Copperhead industries LLC, Rhino TracerPed Triview Green (P692TGI), or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Watertight Construction – It is imperative that all sewers and manholes be built watertight and that the Contractor rigidly adheres to the specifications for material and workmanship. After completion, the sewers or section thereof will be tested and gauged; and if infiltration is observed, the sewer will be rejected.
- B. **Inspection** – All work done and materials furnished shall be subject to the inspection of the Engineer and the Inspector, and all improper work shall be reconstructed. All materials which do not conform to the requirements of the specifications shall be removed from the worksite upon notice being received from the Engineer of the rejection of such materials. The Engineer shall have the right to mark rejected materials and to distinguish them as such.

3.2 EXAMINATION

- A. Verify that trench cut is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.3 PREPARATION

- A. Perform trenching operations per Section 31 23 16.13

- B. Protect and support existing sewer lines, utilities, and appurtenances in accordance with Section 31 23 16.13 and the Occupational safety and health act (OSHA) of 1970 (PL 91-596), as amended.
- C. Utilities:
 - 1. Coordinate with other utilities and the Engineer to eliminate interference.
 - 2. Notify Engineer if crossing conflicts occur.

3.4 INSTALLATION:

- A. The Contractor shall assume responsibility for all materials and equipment stored, protection of his product and compliance with all federal, state and local safety regulations.
- B. Care shall be taken in loading, transporting, and unloading to prevent damage to pipe or fittings. Pipe or fittings shall not be dropped. All pipe and fittings shall be examined before laying, and the Engineer notified of any defect. No piece shall be installed which is defective. Only outside slings shall be used for lifting. Under no conditions shall lifting be from interior surfaces. The Contractor shall be responsible for all materials furnished by him and shall replace all such material found defective in manufacture or damaged in handling after delivery at no additional cost to the Owner.
- C. Gravity sewer pipes, structures and manholes shall be installed and tested as specified to the grades, elevations, alignments, and orientations shown on the drawings within the following tolerances:
 - 1. Pipe center line horizontal position at any point: ± 0.50 feet
 - 2. Pipe center line horizontal position difference between any two joints (maximum): 0.10 feet
 - 3. Elevations of bases, openings, appurtenances, and tops of any structure or manhole (except pipe invert elevations): ± 0.10 feet
 - 4. Horizontal orientation (rotation) of any structure or manhole or any pipe penetration face: ± 2.0 degrees
- D. Under no circumstances should installation of sewer pipes, structures, and manholes to the tolerances specified herein result in a reverse grade. Any pipe, structures, and manholes outside of these tolerances or at an inverse grade shall be removed and replaced with correct work. Materials may be reinstalled only as approved in writing by the Engineer. Otherwise, removed pipe and manholes shall be removed from the site and replaced at no additional cost to the Owner.
- E. Joints shall be made in the following manner:
 - 1. Mechanical Joint: Mechanical joints shall be in accordance with AWWA C600 and the instructions of the manufacturer. Pipe lubricant shall meet the requirements of AWWA C111.
 - 2. Push-on joints shall be made in strict accordance with the manufacturer's instructions.
 - 3. Pipe shall be laid with bell ends upstream.
 - 4. Flange Joints: Flange joints conforming to AWWA C110 can be joined with Class 125 B16.1 flanges shown in ANSI B16.1 but not with Class 250 B16.1 flanges. Flange joints should be fitted so that the contact faces bear uniformly on the gasket. The joint should be made with relatively uniform bolt stress.

- F. All PVC sewer pipe shall be laid in strict accordance with ASTM 2321, and only crushed stone bedding as described elsewhere in these specifications shall be used
- G. All HDPE Force mains shall be installed in accordance with the requirements of ASTM D2321. Class IV and Class V materials shall not be used in the pipe zone.
- H. All ductile iron pipe and fittings shall be installed in conformance with AWWA C600.
- I. A laser beam device shall be used to ensure correct horizontal and vertical alignment for all gravity sewer pipe. The laser beam shall be of a type approved by the Engineer. Each laser beam shall be calibrated at the factory before being used for this work. At 30 day intervals, each laser beam device shall be field checked and recalibrated if necessary by the manufacturer and a certificate authenticating its accuracy provided to the Engineer.
- J. Before the pipe is placed in position, the bottom of the trench shall be uniformly graded and bedding stone placed so that the pipe will have a bearing for its full length. As each section of pipe is set in place a small excavation shall be made to provide a place for the bell.
- K. All sewer pipe shall be laid upgrade with the spigots pointing downgrade. The pipe and specials shall be so laid in the trench that after the sewer is completed the interior surface shall conform on the bottom accurately to the grades and alignment fixed or given by the Engineer.
- L. All pipe shall be carefully examined for cracks or other defects, and no pipe shall be laid which is found defective. If any pipe is found to be defective after being laid, it shall be removed and replaced with sound pipe without further charge.
- M. The interior of the pipe shall be carefully freed of all dirt and superfluous material of every description as the work proceeds.
- N. No pipe shall be laid on blocking of any kind except by express permission of the Engineer, and then only at manholes or other structures where temporary blocking may facilitate installation of the pipe. After installation of the pipe, such blocking shall be carefully removed, and all voids left by the blocking shall be filled with selected materials and tamped.
- O. The bell of each joint shall be wiped clean before the gasket is inserted in it and the gasket covered with lubricant meeting the requirements of AWWA C111 before the pipe sections are jointed together.
 - 1. No joints shall be made where surfaces of pipe and bell to be joined have been soiled by earth in handling until such soiled surfaces are so thoroughly cleaned by brushing and wiping that all traces of the earth are removed.
 - 2. The surfaces of pipe to be joined, as well as the gaskets, shall be cleaned and lubricated. Whatever lubricating agent is used, it shall not be injurious or detrimental to the gasket.
- P. After each joint is installed, the gasket shall be checked for proper position prior to installation of the succeeding length of pipe.
- Q. Where pipe laying is suspended at the lunch hour, at night, during inclement weather or at any other time, the open end of the pipe line shall be provided with a tight fitting plug in order to prevent the entrance of dirt, mud and animals.

- R. The Contractor shall be responsible for removing and cleaning any foreign debris that enters the sewer system.
- S. Wye-branches shall be installed in the line opposite every house, and in other locations if so directed by the Engineer. Any omission of these appurtenances shall be corrected by the Contractor without additional cost to the Owner. The Contractor shall maintain a complete and accurate record showing the location of each wye-branch installed. The locations will be given as a distance up grade from each manhole. The written record may be kept on the cut sheet provided by the Engineer and shall be given to him on completion of each line. The record shall state whether the wye-branch is facing right or left when looking up grade and if riser pipe is installed, the amount shall be recorded. In each instance the Contractor will make every effort to install the wye-branch at the location requested by the property owner.
- T. Backfill trench as shown on the Drawings and in accordance with Section 31 23 16.13 of these specifications.
 - 1. Unless otherwise shown on the Drawings, ductile iron pipe shall be installed in a Type 4 standard laying condition per AWWA C151.
- U. All disturbed areas along the pipeline shall be grassed as soon as possible after backfilling operations have been completed.
 - 1. The maximum length of area disturbed before soil stabilization techniques will be required shall be 500 feet.
 - 2. Seeding and Restorations shall be per Section 32 92 19 of these specifications.

3.5 OBSTRUCTIONS

- A. Each building, wall, fence, pole, bridge, railroad, driveway or other property or improvement encountered is to be carefully protected from all injury, and in the event that any of the foregoing are damaged or removed during the progress of the work the same shall be repaired or replaced within a reasonable time, and before final acceptance of the work shall be returned to as good condition as before the work started. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays and the danger of injury resulting therefrom, and the Contractor must use care in all phases of the construction work, for he will be held liable for damages caused by carelessness.
- B. In excavating, backfilling and laying pipe care must be taken not to remove, disturb or injure any water or sewer pipes or other conduits or structures. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation, and within a reasonable time shall repair any damage done to them. Before final acceptance of the work, he shall return all such structures to as good condition as before the work started.
- C. Unless otherwise specifically addressed on the drawings, sewers shall be laid at least ten (10) feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge.
- D. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the

sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

- E. When necessary, the Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any pipes, conduits, etc., and shall abide by their regulations governing such work. In the event that any subsurface structure becomes broken or damaged in the prosecution of the work, the Contractor shall immediately notify the proper authorities, and shall be responsible for all damage to persons or property caused by such breaks. Failure of the Contractor to promptly notify the affected authorities shall make him liable for any needless loss or for interference with the normal operation of the utility.
- F. When pipes or conduits providing service to adjoining buildings are broken during the progress of the work, the Contractor shall repair them at once at his own expense, or if required by the utility involved, shall pay the utility the proper charges for having such repairs made by the utility's own forces. Delays, such as would result in buildings being without service overnight or for a needlessly long period during the day, will not be tolerated, and the Owner reserves the right to make repairs at the Contractor's expense without prior notice. Should it become necessary to move the position of a pipe, conduit or structure it will be done by the Contractor in strict accordance with the instructions given by the Engineer or utility involved.
- G. The Contractor shall notify all utilities involved of his intention to excavate in the locations specified and request that any underground utilities be located in advance of the construction work. Where ordered by the Engineer, the Contractor shall uncover subsurface obstructions in advance of construction so that the method of avoiding them may be determined before pipe laying reaches the obstruction.

3.6 CONNECTIONS TO EXISTING SANITARY SEWERS OR MANHOLES

- A. Connections to gravity sewers shall be made by core drilling a hole (no sledge hammer) in the wall of the existing structure of the proper size to insert the required rubber boot, and a length of sewer pipe into the hole, filling around pipe and boot with non-shrink vinyl-based grout or water plug, and troweling the inside and outside surfaces of the joint to a smooth finish. The bottom of the manhole shall be rebuilt and formed as necessary to fit the invert of the sewer as shown on the drawings for new manholes. High-early strength cement mortar mixed with an approved non-shrink epoxy grout shall be used to minimize interruptions in sewer service. The Contractor shall perform any work needed to temporarily block or divert waste flows to complete the connection without spillage of the waste.
- B. All existing connections to shall be tightly plugged and blocked to prevent the entrance of construction debris (cement, rocks, mud, silt, flushing water, etc.). The discharge of these materials to the Sanitary Sewer System during construction is prohibited. It is the Contractor's responsibility to secure and plug the system during the construction period to prevent entrance of unexpected rainwater, mud, and silt.

3.7 PIPELINES UNDER PAVEMENT

- A. Where sewers are to be laid under pavement, and the installation of casing pipe or the use of cast iron pipe inserted in a bored hole is not required or specified, the Contractor will be permitted to cut and replace this pavement. In the event that subsurface operations result in

injury or damage to the pavement, the necessary repairs shall be made by the Contractor at no additional cost to the Owner. In the event of the pavement on either side of the pipe line cracking or otherwise becoming disturbed or broken due to Contractor's operations, he shall repair or replace same at his own expense and without additional compensation.

- B. In the event of the State Highway Department requiring a bond or certified check to guarantee the replacement of highway paving, the Contractor shall furnish this security at his own expense.
- C. Where pipelines are to be laid underneath paved sidewalks, the Contractor will be required to install them by; means of tunneling, and where it becomes necessary to cut and replace the sidewalk it shall be replaced as soon as practicable after the trench has been backfilled and tamped. The replaced surface shall be 12 inches wider than the width of the trench, the excess width being equally distributed on both sides.
- D. The Contractor will receive no additional compensation for laying sewers under pavement unless this item of work is set up as a separate item in the Proposal.

3.8 TRAFFIC CONTROL

- A. It shall be the responsibility of the Contractor for all traffic control along any portion of the job. Where required, all necessary flagmen, traffic cones and traffic control plans shall be in place on both County roads and State highways to meet road department specifications.
- B. Traffic control plan shall be in conformance with the Manual on Uniform Traffic Control Devices. In the event actual physical conditions warrant additional traffic control devices, they shall be installed in conformance with the M.U.T.C.D. as directed by the South Carolina Department of Transportation District Engineer.
- C. It should be noted that work for this project takes place along a very busy section of four-lane highway. The contractor shall be familiar with the project area prior to bid and implement an effective traffic control plan in accordance with the M.U.T.C.D.

3.9 FIELD QUALITY CONTROL

- A. Test Pipe per Section 33 01 30.13
- B. Compaction Testing per Section 31 23 16.13
- C. As each section of the work is completed it shall be thoroughly cleaned and all excess mortar, earth, brick or other foreign matter removed. Before acceptance of the work the system as a whole shall be cleaned and inspected and a full circle of light shall show in all sewer between manholes.
- D. The Contractor will be responsible for supplying the Engineer with accurate record drawings per Section 01 78 39 at the conclusion of the project. The Contractor will be responsible for keeping "as built" drawings current throughout the duration of the project. Pay requests will not be approved unless "as built" drawings are accurate and are kept current with the work that has been performed.

- E. Final CCTV Inspection: The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, in the presence of the Owner after installation of all new sewer pipes. A digital copy of the final inspection shall be provided to the owner and to the engineer. All costs associated with the final CCTV Inspection shall be included in the price bid for pipe.

3.10 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
- B. Wherever possible, topsoil shall be removed from all areas to be disturbed by construction, and stockpiled. Land exposure shall be minimized in terms of area and time. All exposed areas subject to erosion shall be covered as quickly as possible by the grassing and seeding specified elsewhere or by mulching or vegetation. Natural vegetation shall be retained whenever possible.

END OF SECTION 33 31 00

SECTION 40 05 06 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe penetrations.
2. Restrained joints.
3. Braided flexible connections.
4. Expansion joints.
5. Expansion loops.
6. Sleeve-type couplings.
7. Wall sleeve.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 96 00 – High-Performance Coatings
3. Division 40 – Process Interconnections

C. Conform to the requirements of Section 40 05 13 – Common Requirements for Process Piping

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
2. AWWA C227 Bolted, Split-Sleeve Restrained and Nonrestrained Couplings for Plain-End Pipe.

B. American Welding Society:

1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

C. ASME International:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. ASME B31.3 - Process Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding, Brazing, and Fusing Qualifications.

D. ASTM International:

1. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 3. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 4. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- E. Expansion Joint Manufacturers Association, Inc.:
1. EJMA Standards.
- F. NSF International:
1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.
- G. UL:
1. UL 263 - Fire Tests of Building Construction and Materials.
 2. UL 1479 - Fire Tests of Through-Penetration Firestops.
 3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

PART 2 - PRODUCTS

2.1 PIPE PENETRATIONS

- A. Flashing:
1. Metal Flashing:
 - a. Material: 304 stainless steel.
 - b. Thickness: 26 gage.
 2. Metal Counterflashing:
 - a. Material: 304 stainless steel.
 - b. Thickness: 22 gage.
 3. Flexible Flashing Materials:
 - a. Material: Butyl sheet, PVC sheet, or Compatible with service conditions.
 - b. Thickness: 47 mils.
 4. Caps:
 - a. Material: 304 stainless steel.
 - b. Minimum Thickness: 22 gage, and 16 gage at fire-resistive elements.
- B. Sleeves:

1. Sleeves for Pipes through Non-fire-rated Floors:
 - a. Material: 304 stainless steel.
 - b. Thickness: 0.0625 inch minimum
2. Sealant:
 - a. As specified in Section 07 92 00 - Joint Sealants.

C. Mechanical Sleeve Seals:

1. Manufacturers:
 - a. Flexicraft Industries, PipeSeal
 - b. GPT (Link-Seal)
 - c. Or Approval Equal
2. Description:
 - a. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve.
 - b. Connection: Bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.2 RESTRAINED JOINTS

A. Flange Adapter (Set Screws)

1. Manufacturer:
 - a. EZ Flange Adapter (EBAA Iron, Inc.)
 - b. Uni-Flange, series 400 (OR series 420)
 - c. Ford Meter Box Company, Inc. (Nappco, Inc.)
 - d. Star Pipe Series 400
 - e. Or Approved Equal.
2. Description:
 - a. The uniflange assembly shall be used only in instances shown on the drawings. If the Contractor proposes to use uniflanges at other locations, he shall first obtain approval from the Engineer.
 - b. The uniflange shall consist of a Ductile Iron ASTM A536 Grade 65-45-12 flange with ANSI B16.1 Class 125 & 250 or ANSI B16.5 Class 150 & 300 drillings.
 - c. The standard gasket of Buna S for water and wastewater shall be supplied.
 - d. The uniflange class shall be suitable for the pressure service. (2"-12" = 250 psi, 14"-24" = 150psi, >24" = 100 psi)

B. Flange Adapter-Restrained

1. Manufacturer:

- a. SERIES 2100 MEGAFLANGE adapter, as produced by EBAA Iron, Inc.,
- b. Star Flange Series 3200
- c. Or Approved Equal.

2. Description:

- a. Restrained flange adapters may be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
- b. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
- c. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- d. Flange Adapters shall be fully restrained and shall incorporate a wedge style grip.
- e. Allowable working pressures shall have a minimum as follows: 3"-16" = 350psi, 18"-24" = 250 psi, 30"-48" = 150psi.

C. Adapter with Wedge Restraints for Mechanical Joint pipe.

1. Manufacturer:

- a. Uni-Flange Series 1400, by Ford Meter Box Company
- b. StarGrip 3000 by Star Pipe Products
- c. Megalug Series 1100 by EBBA Iron Sales, Inc.
- d. Or Approved Equal.

2. Description:

- a. Restraint for standardized mechanical joints shall be incorporated into the design of the follower gland and shall impart multiple points of wedge action against the pipe, increasing its resistance as the pressure increases.
- b. The restrained joint shall incorporate a wedge style restraint system. Restraints with set screws will not be acceptable.
- c. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action.
- d. Restraining glands shall be manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12.
- e. Wedges shall be contoured to properly fit on the pipe, and shall be manufactured of ductile iron, heat treated to a minimum hardness of 370 BHN. Dimensions of the glands shall be such that they can be used with the standardized mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision.
- f. Twist-off heads shall be incorporated in the design of the wedge actuating screws to ensure proper torque.
- g. The mechanical joint restraining device shall have a water working pressure rating of 250 psi minimum with a safety factor of at least 2:1 against separation when tested in a dead-end situation

- h. Allowable working pressures shall be as follows: 3"-16" = 350psi, 18"-36" = 250psi.

2.3 BRAIDED FLEXIBLE CONNECTIONS

A. Manufacturers:

- 1. Flexicraft Industries
- 2. Flex-Weld, Inc.
- 3. Hyspan Precision Products, Inc.
- 4. Or Approved Equal.

B. Steel or Stainless-Steel Piping:

- 1. Inner Hose: Corrugated stainless steel as indicated.
- 2. Exterior Sleeve: Braided or stainless steel as indicated.
- 3. Pressure Rating: Minimum 150 psig at 50 degrees F and sufficient for service condition.
- 4. Fittings: Flanged, unless otherwise noted.
- 5. Size: Use pipe-sized units.
- 6. Maximum Offset: 3/4inch on each side of installed center line.

C. Copper Piping:

- 1. Inner Hose: Corrugated Bronze.
- 2. Exterior Sleeve: Braided bronze.
- 3. Pressure Rating: Minimum 150 psig at 70 degrees F and sufficient for service condition.
- 4. Fittings: Threaded with union, Soldered, or As specified for pipe joints.
- 5. Size: Use pipe-sized units.
- 6. Maximum Offset: 3/4 inch on each side of installed center line.

2.4 EXPANSION JOINTS

A. Manufacturers:

- 1. Flexicraft Industries
- 2. Flex-Weld, Inc.
- 3. Hyspan Precision Products, Inc.
- 4. Or Approved Equal

B. Performance and Design Criteria:

- 1. Bellow Design: According to Section C of EJMA Standards.

C. Stainless-Steel Compensator Type:

- 1. Pressure Rating: 50 psig WOG at 250 degrees F for aeration air piping, all others shall be 200 psig WOG at 250 degrees F.
- 2. Maximum Compression: 1-3/4 inches.
- 3. Maximum Extension: 1/4 inch.

4. Joint: Flanged, unless otherwise noted.
5. Size: Use pipe-sized units.
6. Application: Aeration air piping 4-inch and larger or steel piping 3 inches and smaller.

D. External Ring-Controlled Stainless-Steel Bellows Type:

1. Pressure Rating: 200 psig WOG at 250 degrees F.
2. Maximum Compression: 1-1/4 inches.
3. Maximum Extension: 3/8 inch.
4. Maximum Offset: 5/16 inch.
5. Joint: Flanged.
6. Size: Use pipe-sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inches and larger.

E. Single-Arch Rubber Type:

1. Body: Neoprene with nylon fabric reinforcement.
2. Working Pressure: 150 psig.
3. Maximum Temperature: 200 degrees F.
4. Maximum Compression: 1 inch.
5. Maximum Elongation: 5/8 inch.
6. Maximum Offset: 1/2 inch.
7. Maximum Angular Movement: 30 degrees.
8. Joint: 304 stainless steel tapped backing rings.
9. Size: Use pipe-sized units.
10. Accessories: Control rods.
11. Application: Steel piping 2 inches and larger.

F. Bronze Compensator Type:

1. Description: Bronze with anti-torque device, limit stops, and internal guides.
2. Pressure Rating: 200 psig WOG at 250 degrees F.
3. Maximum Compression: 3 inches.
4. Maximum Extension: 1/4 inch.
5. Size: Use pipe-sized units.
6. Application: Copper piping.

2.5 EXPANSION LOOPS

- A. Provide expansion loops as indicated on Shop Drawings.

2.6 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. Dresser Piping Specialties
2. The Macomb Group
3. US Pipe Fabrication

B. Description:

1. Comply with AWWA C219.
2. Middle Ring: Epoxy Coated Steel.
3. Followers: Epoxy Coated Steel.
4. Gaskets:
 - a. Material: Buna-N, EPDM, or Compatible with service conditions.
 - b. Comply with ASTM D2000.
5. Bolts: AWWA C111, Epoxy Coated Steel.

2.7 WALL SLEEVE

A. Manufacturers:

1. Sigma – Omni-Sleeve.
2. American
3. Or Approved Equal.

B. Description:

1. Wall and floor pipe penetrations of ductile iron piping systems shall be made by means of a sleeve capable of being bolted directly to the formwork to prevent misalignment. Seal of annular space shall be by means of a confined rubber gasket, so as not to be affected by vibration and capable of withstanding up to 100 psig. Sleeve shall be manufactured from Ductile Iron with an integrally cast water stop.

2.8 FINISHES

- A. Prepare ferrous metal piping appurtenances for field finishes as specified in Section 099600 – High-Performance Coatings.

2.9 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

1. Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.
- D. Verify that openings are ready to receive sleeves.
- E. Verify that pipe plain ends to receive sleeve-type couplings or flange adapters are smooth and round for 12 inches from pipe ends.
- F. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to ASME B31.3 for process piping and ASME B31.9 for building services piping.
- B. Coating: Finish ferrous metal piping appurtenances as specified in Section 09 96 00 – High-Performance Coatings for service conditions.
- C. Pipe Penetrations:
 - 1. Flashing:
 - a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
 - b. Flash floor drains with topping over finished areas with lead, 10 inches clear on sides, with minimum 36-by-36-inch sheet size.
 - c. Fasten flashing to drain clamp device.
 - 2. Sleeves:

- a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
- b. Set sleeves in position in forms and provide reinforcement around sleeves.
- c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
- d. Extend sleeves through floors 1/2 inches above finished floor level and calk sleeves.
- e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with insulation and calk airtight.
- f. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
- g. Install stainless-steel escutcheons at finished surfaces.

D. Firestopping:

1. Placement: Place intumescent coating in sufficient coats to achieve rating required.
2. Fire-Rated Surfaces:
 - a. Seal opening at floor, wall, partition, ceiling and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve, allowing minimum of 1-inch void between sleeve and building element.
 - d. Pack void with backing material.
 - e. Seal ends of sleeve with UL-listed, fire-resistive silicone compound to meet fire rating of structure penetrated.
3. Non-rated Surfaces:
 - a. Seal opening through non-fire-rated floor, wall, partition, ceiling and roof.
 - b. Install sleeve through opening and extend beyond minimum of 1 inch on both sides of building element.
 - c. Size sleeve to allow minimum of 1-inch void between sleeve and building element.
 - d. Install type of firestopping material recommended by manufacturer.
 - e. Occupied Spaces:
 - 1) Install escutcheons, floor plates, or ceiling plates where conduit penetrates non-fire-rated surfaces in occupied spaces.
 - 2) Occupied spaces include rooms with finished ceilings and rooms where penetration occurs below finished ceiling.
 - f. Exterior Wall Openings below Grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place according to manufacturer instructions.
 - g. Interior Partitions:
 - 1) Seal pipe penetrations at where indicated.
 - 2) Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

- E. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Shop Drawings.

F. Expansion Joints:

1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Drawings.
2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.

G. Air Release and Vacuum Breakers: Provide vacuum breakers on all tanks and process equipment.

H. Backflow Preventers:

1. Install with nameplate and test cock accessible.
2. Install according to local code requirements.
3. Do not install in vertical position.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. After installation, inspect for proper supports and interferences.
- D. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep equipment interior clean as installation progresses.

END OF SECTION 40 05 06

SECTION 40 05 07 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Structural attachments.
4. Pipe guides.
5. Guides
6. Anchors
7. Elbow and Flange Supports

B. Related Requirements:

1. List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section, as well as Sections required to describe complete system or assembly requirements.
2. Section 03 30 00 - Cast-in-Place Concrete
3. Division 05 – Metals
4. Section 07 92 00 – Joint Sealants
5. Section 09 96 00 – High-Performance Coatings
6. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B31.1 - Power Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
3. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
4. ASTM A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code Steel - Reference Manual.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

- A. Section 01 31 00 – Project Management and Coordination
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Section 01 31 00 – Project Management and Coordination

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Shop Drawings: Indicate system layout with location - including critical dimensions, sizes, and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX or AWS D1.1, verifying qualification within previous 12 months.
- F. Delegated Design Submittals:
 1. Submit signed and sealed Shop Drawings with design calculations and assumptions for load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 2. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 3. Submit sizing methods or calculations sealed by a registered professional engineer.
- G. Manufacturers' Instructions: Submit special procedures and assembly of components.
- H. Qualifications Statements:
 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
 2. Submit manufacturer's approval of installer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.

1.7 QUALITY ASSURANCE

- A. Perform Work according to applicable authority and/or AWS D1.1 for welding hanger and support attachments to building structure.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum five years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of South Carolina.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.10 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls
- B. Provide ventilation in areas receiving solvent-cured materials.

1.11 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Description:

1. HORIZONTAL-PIPING HANGERS AND SUPPORTS

- a. General: Except as otherwise indicated, provide factory-fabricated horizontal piping hangers and supports of MSS type and size indicated, bolts (if any) and washers; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information; size hangers and supports properly for piping including insulation (if any). Provide copper-plated hangers and supports for uninsulated copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

2. VERTICAL-PIPING CLAMPS

- a. General: Except as otherwise indicated, provide factory-fabricated vertical piping clamps of MSS type and size indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size clamps properly for piping, including insulation (if any). Provide copper-plated clamps for copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

3. HANGER-ROD ATTACHMENTS

- a. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of MSS type and size indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or size is not indicated, provide proper selection determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size attachments properly for piping, including insulation (if any).

Provide copper-plated hanger-rod attachments for uninsulated copper-piping systems. Provide 304 stainless steel supports and hangers for stainless steel piping systems.

4. STRUCTURAL ATTACHMENTS

- a. General: Except as otherwise indicated, provide factory-fabricated building attachments of MSS type and load-rating indicated; comply with MSS SP-58 and manufacturer's published product information. Where MSS type or load-rating is not indicated, provide proper selection determined by Installer for installation requirements, and comply with MSS SP-69 and manufacturer's published product information. Size units properly for the piping loading.

B. Performance and Design Criteria:

1. General

- a. Design, size and locate piping support systems throughout facility, whether shown or not.
- b. Piping smaller than 30 inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
- c. Piping 30 inches and Larger: N/A
- d. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this Section.

2. Pipe Support Systems

- a. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
- b. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.

3. Anchoring Devices: Design, size and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

4. Vertical Sway Bracing: 10-foot maximum centers or as shown.

5. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.

6. Provide linkage to permit lateral or axial movement where anticipated.

7. Where horizontal pipe movement is greater than ½ inch, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.

8. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances.

9. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.

10. Point Loads:

- a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.

- b. Avoid point loads on plastic piping by providing extra wide pipe saddles or galvanized steel shields.

2.2 HANGERS

A. Clevis: MSS SP 58, Type 1

- 1. Shall be used for the suspension of non-insulated pipe or insulated with B3151 shield or Anvil ISS

- a. Shall be used for the suspension of non-insulated pipe or insulated with B3151 shield or Anvil ISS

- 1) B-Line; Figure B3100, 1/2 inch to 30 inches
- 2) Anvil; Figure 260 for steel pipe and Figure 590, 1/2 inch to 30 inches
- 3) Insulated Steel Pipe; B-Line; Figure B3100 with B3151 shield, 1/2 inch through 16 inches
- 4) Insulated Steel Pipe; Anvil; Figure 260 with insulated saddle system (ISS), 1/2 inch through 12 inches
- 5) Or Approved Equal

- b. Adjustable Swivel Split-Ring Pipe Clamp: MSS SP 58, Type 6

- a. Shall be used for suspension of non-insulated stationary pipe

- 1) B-Line; Figure B3171, : 3/4 inch through 8 inches
- 2) Anvil; Figure 104, : 3/4 inch through 8 inches
- 3) Or Approved Equal

- c. Steel Yoke Pipe Rolls and Roller Supports: MSS SP 58, Type 41 or Type 43

- a. Shall be used to support pipe where movement may occur due to thermal expansion

- 1) B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.
- 2) Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches and Figure 171 for sizes 1 inch through 30 inches
- 3) Or Approved Equal

- d. Pipe Rollers and Supports: MSS SP 58, Type 44

- a. Shall be used to support pipe where movement may occur due to thermal expansion when ceiling suspension is impractical

- 1) B-Line; Figure B3120, sizes 2 inches through 24 inches
- 2) Anvil; Figure 175, sizes 2 inches through 30 inches
- 3) Or Approved Equal

2.2 HANGER RODS

A. Hanger Rods:

1. ASTM A576, steel.
2. Threaded both ends or Threaded one end or All-thread.
3. Diameter: ASME B31.1; as indicated on Drawings.

2.3 STRUCTURAL ATTACHMENTS

A. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy duty)

1. Anvil; Figure 199, 3,000-pound rating.
2. B-Line; Figure B3067, 3,000-pound rating.
3. Or Approved Equal

B. Adjustable "J" hanger MSS SP 58, Type 5:

1. Anvil; Figure 67, sizes ½ inch through 8 inches.
2. B-Line: Figure B3690, sizes ½ inch through 8 inches.
3. Or Approved Equal

C. Channel Type

1. General Use
 - a. Unistrut
 - b. Anvil: Power Strut
 - c. B-Line; Strut System
 - d. Or Approved Equal

2.4 PIPE SADDLES

A. Provide 90-degree to 120-degree pipe saddle for pipe 6 inches and larger with baseplates drilled for anchors bolts.

1. Sizes 20 inches through 60 inches, Piping Technology & Products, Inc.; Figure 2000.
2. Or Approved Equal

B. Saddle Supports, Pedestal Type

1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
2. Nonadjustable Saddle: MSS SP, Type 37 with U-bolt
 - a. B-Line; Figure B3090, sizes ¾ inch through 36 inches with B3088S base
 - b. Anvil: Figure 259; sizes 4 inch through 36 inches with Figure 63C base
 - c. Or Approved Equal
3. Adjustable Saddle: MSS SP 58, Type 38 without clamp

- a. B-Line; Figure B3093, sizes 1 inch through 36 inches with Figure B3088S base.
- b. Anvil; Figure 264, sizes 2-1/2 inch through 36 inches with Figure 62C base.
- c. Or Approved Equal

2.5 CHANNEL TYPE SUPPORT SYSTEMS

- A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.
- B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.
- C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.
- D. Manufacturers and Products:
 - 1. General Use
 - a. B-Line; Strut System.
 - b. Unistrut
 - c. Anvil; Power-Strut.
 - d. Or Approved Equal

2.6 CLAMPS AND BEAM ATTACHMENTS

- A. Beam Clamps:
 - 1. Shall be used for suspending hanger rod from flanged beam and shall distribute the load equally on both sides of the beam.
 - 2. MSS SP-58 Type 21, Type 28, Type 30
 - 3. ASTM A36, steel or ASTM A181, forged steel.
 - 4. Clamp Size: Based on load to be supported and load configuration.
 - 5. Anchoring: Locknuts and cup-point set screws.
 - 6. Reversible top or bottom flange.
 - 7. Manufacturers:
 - a. B-Line;
 - b. Anvil;
 - c. Or Approved Equal
- B. Offset Clamps:
 - 1. Shall be used to support pipe offset from the floor or wall.
 - 2. Double leg, two-piece.
 - a. B-Line; B3148; sizes 3/4 inch through 12 inches
 - b. Anvil; Figure 103; sizes 3/4 inch through 8 inches
 - c. Or Approved Equal
- C. Welded Beam Attachment: MSS SP 58, Type 22

1. B-Line; Figure B3083, sizes 3/8"-16 through 2"-4 1/2 rod
2. Anvil; Figure 66, sizes 3/8 inch through 3-1/2 inch

2.7 ELBOW AND FLANGE SUPPORTS

- A. Elbow and Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base or approved equal
- B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or 63B base or approved equal.
- C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89 or approved equal.

2.8 PIPE GUIDES

- A. Intermediate Guides:
 1. Type: Hold down pipe guide
 - a. Shall prevent longitudinal or lateral movement of pipe
 - a. B-Line; Figure B3256 sizes 2 inch through 30 inches
 - b. Or Approved Equal
 2. Type: U-bolts with 4 hex nuts to provide nominal 1/8 inch to 1/4 inch clearance around pipe; MSS SP 58 Type 24
 - a. Shall be used for support, anchor, or guide of pipe
 - a. B-Line; Figure B3188 and Figure B3188NS, sizes 1/2 inch through 30 inches
 - b. Anvil; Figure 137 and Figure 137S, sizes 1/2 inch through 36 inches
 - c. Or Approved Equal
- B. Alignment Guides:
 1. Type: Spider
 - a. Shall direct thermal expansion of insulated or non-insulated pipe in direction permitted by expansion joints or loops
 - b. Two or more guides shall be used on both sides of expansion joint or loop
 - a. B-Line; Figure B3281 through B 3287, sizes 1-1/2 inch through 24 inches
 - b. Anvil; Figure 255, sizes 1/2 inch through 24 inches
 - c. Or Approved Equal

2.9 PIPE ANCHORS

- A. Type: Anchor chair with U-bolt strap

1. Shall be used to anchor pipe to structure
 - a. B-Line; Figure 3147A and 3147B, sizes ½ inch through 24 inches
 - b. Or Approved Equal

2.10 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: ½-inch minimum diameter, and as specified in Section 0 55 00, Metal Fabrications.
2. Bolt Length (Extension Above Top of Nut):
 - a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.
 - b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer:
 - a. B-Line; B1999 Vibra Cushion.
 - b. B-Line; Iso Pipe, Isolation Tape.
 - c. Or Approved Equal

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers:
 - a. B-Line; Figure B3151, sizes ½ inch through 24 inch.
 - b. Anvil; Figure 167, sizes ½ inch through 24 inches.
 - c. Or Approved Equal

D. Welding Insulation Saddles:

1. Type: MSS SP 58, Type 39.
2. Manufacturers:
 - a. B-Line; Figure Series B3160, sizes ½ inch through 24 inches.
 - b. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
 - c. Or Approved Equal

E. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing
2. Manufacturer

- a. B-Line; Figure Series B3106V, sizes ½ inch through 6 inches with Figure B3106 Vee bottom hanger.
 - b. Or Approved Equal
- F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.
- G. Attachments:
 - 1. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
 - 2. Concrete Attachment Plates:
 - a. B-Line; Figure B3084, Figure B3085, or Figure B3086 with B3201 to attach center lug.
 - b. Anvil: Figure 47, Figure 49, or Figure 52.
 - c. Or Approved Equal

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 – Project Management and Coordination.
- B. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of or recessed into and grouted flush with slab.
- D. Pipe Hangers and Supports:
 - 1. Install according to: MSS SP 58.
 - 2. Support horizontal piping as indicated on Drawings.
 - 3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.

4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide copper-plated hangers and supports for copper piping or sheet lead packing between hanger or support and piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Support no pipe from pipe above it.
15. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
16. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
17. Do not use adhesive anchors for attachment of supports to ceiling or walls.
18. Use beam clamps where piping is to be suspended from building steel.
19. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
20. Install lateral supports for seismic loads at changes in direction.
21. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
22. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
23. Use offset clamps where pipes are indicated as offset from wall surfaces.
24. Repair mounting surfaces to original condition after attachments are completed.

E. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
2. Conform to 40 42 13 - Process Piping Insulation.

F. Equipment Bases and Supports:

1. Provide housekeeping pads as detailed on Drawings.
2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
3. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
4. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with

G. Prime Coat:

1. Prime coat exposed steel hangers and supports.

2. Conform to Section 09 96 00 – High-Performance Coatings.
3. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 ATTACHMENTS

A. Standard Pipe Supports

1. Horizontal Suspended Piping:
 - a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
 - b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
 - a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
 - b. Stacked Piping: Wall mounted framing system and “J” hangers acceptable for pipe smaller than 3-inch.
 - c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors/Roof:
 - a. Saddle Supports:
 - a. Pedestal Type, elbow and flange.
 - b. Provide minimum 1-1/2-inch grout beneath baseplate.
 - b. Floor Mounted Channel Supports:
 - a. Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
 - b. Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.
 - c. Attach pipe to channel with clips or pipe clamps.
 - c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.
4. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration

B. Standard Attachments:

1. New Concrete Ceilings: Concrete inserts, concrete attachment plates, or concrete anchors as limited below:

- a. Single point attachment to ceiling allowed for only $\frac{3}{4}$ -inch rod and smaller (8 inches and smaller pipe).
 - b. Where there is vibration or bending considerations, do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
2. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:
 - a. Single point attachment to ceiling is allowed only for $\frac{3}{4}$ -inch rod and smaller (8 inches and smaller pipe).
 - b. Where there is a vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.
 - a. These lines include air operated diagram pumps and other lines.
 - c. Steel Beams: I-beam clamp or welded attachments.
 - d. Wooden Beams: Lag screws and angel clips to members not less than 2-1/2 inches thick
 - e. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.
 - f. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.
- C. Saddles for Steel or Concrete Pipe: Provide 90-degree to 120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.
- D. Intermediate and Pipe Alignment Guides:
 1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.
 2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.
 3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.
- E. Accessories:
 1. Insulation Shield: Install on insulated piping with oversize rollers and supports.
 2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.
 3. Dielectric Barrier:
 - a. Provide between painted and galvanized carbon steel members and copper or stainless-steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.
 - b. Install rubber wrap between submerged metal pipe and oversized clamps.
- F. Pipe Hanger Spacing:

1. Pipe Material: Ductile Iron Pipe
 - a. Size: 8 Inches and Under
 - b. Maximum Hanger Spacing: Maximum span limited to that for standard weight steel pipe for water service.
 - a. MSS SP 58 Table 3
 - c. Hanger Rod Diameter: MSS SP 58 Table 4
2. Pipe Material: Ductile Iron Pipe
 - a. Size: 10 Inches and Larger
 - b. Maximum Hanger Spacing: Maximum span limited to 20 feet.
 - a. MSS SP 58 Table 3
 - c. Hanger Rod Diameter: MSS SP 58 Table 4
3. Pipe Material: ABS.
 - a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
4. Pipe Material: Aluminum.
 - a. Maximum Hanger Spacing: 10 feet.
 - b. Hanger Rod Diameter: 1/2 inch.
5. Pipe Material: Cast iron.
 - a. Maximum Hanger Spacing: 5 feet.
 - b. Hanger Rod Diameter: 5/8 inch.
6. Pipe Material: Cast Iron, with 10-foot length of pipe.
 - a. Maximum Hanger Spacing: 10 feet.
 - b. Hanger Rod Diameter: 5/8 inch.
7. Pipe Material: CPVC.
 - a. Size: 1 inch and smaller.
 - b. Maximum Hanger Spacing: 3 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
8. Pipe Material: CPVC.
 - a. Size: 1-1/4 inches and larger.
 - b. Maximum Hanger Spacing: 4 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
9. Pipe Material: Copper tube.

- a. Size: 1-1/4 inches and smaller.
 - b. Maximum Hanger Spacing: 6 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
10. Pipe Material: Copper tube.
- a. Size: 1-1/2 inches and larger.
 - b. Maximum Hanger Spacing: 10 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
11. Pipe Material: Fiberglass:
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 1/2 inch.
12. Pipe Material: Polybutylene.
- a. Maximum Hanger Spacing: 2.7 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
13. Pipe Material: Polypropylene.
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
14. Pipe Material: PVC.
- a. Maximum Hanger Spacing: 4 feet.
 - b. Hanger Rod Diameter: 3/8 inch.
15. Pipe Material: Steel.
- a. Size: 3 inches and smaller.
 - b. Maximum Hanger Spacing: 12 feet.
 - c. Hanger Rod Diameter: 1/2 inch.
16. Pipe Material: Steel or Stainless Steel.
- a. Size: 4 inches and larger.
 - b. Maximum Hanger Spacing: 12 feet.
 - c. Hanger Rod Diameter: 5/8 inch.

END OF SECTION 40 05 07

SECTION 40 05 13 - COMMON REQUIREMENTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Requirements common to pipe and tube of all material types used on the Project.
2. Accessories.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Division 31 – Earthwork.
3. Division 40 – Process Interconnections

1.2 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's catalog information on pipe materials and fittings.

C. Shop Drawings: Indicate layout of piping systems, including equipment, fittings, critical dimensions, sizes, and material lists.

D. Submit manufacturer's certification and certified test reports that the pipe and linings and coatings were manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified. Submittal shall be at least 7 days prior to each shipment of pipe.

E. Material Certificates

F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.

G. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, invert and centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Perform Work according to all applicable Federal, State and Local standards and these specifications.
- B. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.
- C. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

1.6 QUALIFICATIONS

- A. Manufacturer: For each pipe material type, a company specializing in manufacturing products of the material shall be used. The manufacturer shall have successfully manufactured and delivered products of the diameters used in this project for a minimum of 15 projects over the past 5 years.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging; include handling instructions.
- C. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be padded and used in a manner as to prevent damage to the exterior surface or internal coating or lining of the pipe. If any part of the coating or lining is damaged, the repair shall be made by the Contractor.
- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- E. Store piping and appurtenances according to manufacturer instructions.
- F. Protect piping and appurtenances from oxidation by storing off ground.

- G. Stored pipe shall be kept safe from damage and away from traveled ways. The interior of all pipe, fittings and other appurtenances shall be kept free from water, dirt, or foreign matter at all times.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 ACCESSORIES

1. Couplings, Adapters, Specials for Process Piping: As specified in Section 40 05 06 - Couplings, Adapters, Specials for Process Piping
2. Hangers and Supports for Process Piping: As specified in Section 40 05 07 - Hangers and Supports for Process Piping.
3. Process Piping Insulation: As specified in Section 40 42 13 - Process Piping Insulation.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. All pipe and fittings to be installed under this Contract shall be of new manufacture.
- C. The manufacturer is responsible for the performance of all inspection requirements as specified.
- D. Owner Inspection:
 1. The manufacturer is responsible for performance of all inspection requirements as specified. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with these Specifications by the Owner, by an independent testing laboratory selected by the Owner, or by other representative of the Owner.
- E. Certificate of Compliance:
 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on the Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flange mate properly.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Ream ends of threaded pipes and file smooth.
- C. Cleaning: Thoroughly clean pipe and fittings before installation.
- D. Surface Preparation:
 - 1. Touch up shop-primed surfaces with primer as specified in Section 09 96 00 - High-Performance Coatings.
 - 2. Solvent-clean surfaces that are not shop primed.
 - 3. Clean surfaces of metallic pipe to remove loose rust, mill scale, and other foreign substances by power wire brushing or commercial sand blasting; SSPC SP 6/NACE No. 3. Do not sand blast or power wire brush thermoplastic pipe.
 - 4. Prime surface as specified in Section 09 96 00 – High-Performance Coating.

3.3 INSTALLATION

- A. Buried Service: Install pipe as specified in the Section appropriate to the pipe material.
- B. Exposed Service - Install according to ASME B31.3.
- C. Provide required upstream and downstream clearances from devices as indicated.
- D. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- E. Support piping as specified in Section 40 05 07 - Hangers and Supports for Process Piping.
- F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping and pipe guides as specified in Section 40 05 07 - Hangers and Supports for Process Piping to compensate for pipe expansion due to temperature differences.
- G. Dielectric Fittings: Provide between dissimilar metals.

- H. Field Cuts: According to pipe manufacturer's recommendations.
- I. Finish primed surfaces according to Section 09 96 00 – High-Performance Coating.
- J. Run pipelines straight and true, parallel to building lines with a minimum use of offsets and couplings. Provide only such offsets as may be required to provide necessary headroom or clearance and to provide necessary flexibility in pipe lines.
- K. Changes in direction of pipelines shall be made only with fittings or pipe bends. Changes in size shall be made only with fittings. Miter fittings, face or flush bushings, or street elbows shall not be used. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- L. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
- M. Use full and double lengths of pipe wherever possible.
- N. Unless otherwise indicated, install all supply piping, including shut off valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at inlet to control valve or pump. Install supply piping from outlet of control valve at full size to connection of equipment served.
- O. All pipe shall be cut to exact measurement and installed without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment, or building elements with piping connections or piping supports.

3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Laying Tolerances: Unless otherwise specified, laying tolerances will be within 5/8".

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspection:
 - 1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Architect/Engineer.
 - 2. Repair damaged piping or provide new, undamaged pipe.
 - 3. After installation, inspect for proper supports and interferences.

D. Damage:

1. Inspect for damage to pipe lining or coating, or other defects that may be detrimental as determined by Architect/Engineer.
2. Repair damaged piping or provide new undamaged pipe.

E. Pressure Testing:

1. Unless otherwise specified or indicated on the drawings, all pipe shall be pressure tested prior to acceptance.
2. Conduct pressure testing in according to AWWA C600 and following:
 - a. Test Pressure: See sheet G-009 Process Piping Schedule
 - b. Conduct hydrostatic test for at least two hours.
 - c. Slowly fill with water section to be tested; expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled. Raise pressure to specified test pressure.
 - d. Observe joints, fittings, and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
 - e. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate. Maintain pressure within plus or minus 5 psi of test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
 - f. Compute maximum allowable leakage by following formula:
 - 1) $L = SD \times \sqrt{P}/C$.
 - 2) L = testing allowance, in gph.
 - 3) S = length of pipe tested, in feet.
 - 4) D = nominal diameter of pipe, in inches.
 - 5) P = average test pressure during hydrostatic test, in psig.
 - 6) C = 148,000.
 - 7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.
 - g. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
 - h. Correct visible leaks regardless of quantity of leakage.

F. After installation, inspect for proper supports and interferences.

3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep pipe interior clean as installation progresses.
- C. All piping shall be cleaned, flushed, and tested prior to use.

- D. All water lines shall be flushed out under full treated water pressure; potable water piping shall be flushed with potable water; air piping shall be thoroughly blown out with air. All filters, control valves and gages shall be removed from lines or bypassed during the blowout period.
- E. Following the blow through, all dirt legs and other low points in lines shall be disassembled and all residual material thoroughly removed. All stop valves shall be removed and cleaned.
- F. The Contractor shall provide all water required for cleaning, and flushing at no additional cost to the Owner.

END OF SECTION 40 05 13

SECTION 40 05 19 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile-iron pipe and fittings.
2. Accessories.

B. Conform to the requirements of Section 40 05 13 – Common Requirements for Process Piping

C. Related Requirements:

1. Section 09 96 00 – High-Performance Coating
2. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153/A21.53 - Ductile-Iron Compact Fittings.
8. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B31.3 - Process Piping.

C. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

D. SSPC - The Society for Protective Coatings:

1. SSPC SP 6/NACE No. 3 - Commercial Blast Cleaning.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Manufacturers:

1. ACIPCO
2. US Pipe.
3. Griffin Pipe.
4. Or Approved Equal.

B. Piping:

1. Comply with AWWA C151.
2. Diameter and Class: As indicated below:

Pipe Size (in)	Pressure Class
12" and Smaller	350
14" – 24"	350
30" and Larger	350

C. Joints:

1. Pressure Rating: Same as that of connected piping.
2. Mechanical:
 - a. Comply with AWWA C110 and AWWA C111.
 - b. Glands: Ductile iron with asphaltic coating.
 - c. Use Tee-head or non-hex head bolts and head nuts for joint makeup and gasket seating. Bolts & Nuts shall be carbon steel coated with corrosion inhibiting fluoropolymer composite material.
 - d. Mechanical joint fittings hall be furnished with sufficient quantities of accessories as required for each joint.
 - e. All mechanical joints shall be restrained.
3. Push On: Comply with AWWA C111.
4. Flanged: Comply with AWWA C115 with gaskets and bolts conforming to AWWA C115, Appendix A.
5. Gaskets for mechanical and push-on type joints shall conform to ANSI A21.11 and AWWA C111, Gaskets shall be SBR, neoprene, or EPDM.
6. Gaskets for flange joints shall conform to ANSI A21.15 and AWWA C115. Gaskets shall be neoprene or EPDM.
7. Gaskets for joints above 250 psi shall be Toruseal gaskets as manufactured by American specially designed for a working pressure of 350 psi.

D. Fittings:

1. Comply with AWWA C153, ductile iron.
2. Pressure Rating, Pipes 12 Inches and Smaller: 250 psig.

2.2 FINISHES

A. Interior Coating

1. Cement-mortar lining, AWWA C104; standard thickness.
2. Glass-lined SR-14 or equal for grit and scum piping.
3. Ceramic epoxy for gravity and pumped raw wastewater.
4. Ductile Iron Pipe and Fittings used for air service shall be unlined pipe

B. Outside Coating:

1. Buried: Asphaltic; 1-mil thick, minimum, in accordance with AWWA C151 / ANSO A21.51.
2. Exposed: As specified in Section 09 96 00 - High-Performance Coatings.

2.3 ACCESSORIES

A. Jackets:

1. AWWA C105, polyethylene jacket.
2. All buried ductile iron pipe shall receive polyethylene jacketing.

B. Dielectric Fittings: Provide between dissimilar metals.

C. Pipe Identification Labels

1. Identification for Process Piping: As specified in Section 40 05 53 - Identification for Process Piping.

PART 3 - EXECUTION

3.1 EXAMINATION

- ### A. As specified in Section 40 05 13 – Common Requirements for Process Piping

3.2 INSTALLATION

A. Buried Service: Install pipe as specified in:

1. Section 40 05 13 – Common Requirements for Process Piping.
2. AWWA C600 – Installation of Ductile Iron Water Mains and their Appurtenances.

B. Exposed Service: Install pipe as specified in:

1. Section 40 05 13 – Common Requirements for Process Piping.
2. Install according to ASME B31.3.

3. Fittings:

- a. Clean gasket seats thoroughly and wipe gaskets clean prior to installation.
- b. Install fittings according to manufacturer instructions.
- c. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer recommendations.

4. Provide required upstream and downstream clearances from devices as indicated.

- C. Tap ductile-iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.
- D. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means acceptable to the Engineer.
- E. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining so as to leave a smooth end at right angles to the axis of the pipe.
- F. Where pipe is laid on a grade of ten (10) percent or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade.

3.3 JOINING OF PIPE

A. Flanged Joints

1. Flanges conforming to AWWA C110 can be joined with Class 125 B16.1 flanges shown in ANSI B16.1 but not with Class 250 B16.1 flanges.
2. Flange joints should be fitted so that the contact faces bear uniformly on the gasket. The joint should be made with relatively uniform bolt stress.
3. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts such that those 180 degrees apart or directly opposite are torqued in sequence.

B. Push-On Joint

1. Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends upstream.
2. Pipe 8 inches in diameter and larger shall be socketed by fork tools or jacks.
3. Pipe cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The spigot ends of field cut pipe shall be tapered back 1/8 inch at an angle of about 30 degrees to the barrel of the pipe with a coarse file or portable grinder. All sharp or rough edges that may injure the rubber gasket shall be removed in this operation.
4. Whenever it is desirable to deflect push-on joint pie, the amount of deflection shall not exceed the maximum limits according to Table 4 in AWWA C600.

C. Mechanical Joints:

1. Mechanical joints shall be in accordance with AWWA C600 and the manufacturer's instructions.
2. Bell ends shall be laid upstream.
3. Bolts shall be tightened to the specified torque. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to obtain greater leverage.
4. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
5. Bolts shall not be over-stressed to compensate for poor assembly.

3.4 PLACEMENT OF FITTINGS

1. Pipeline fittings, plugs, and caps shall be furnished and installed of the type indicated and at the location shown on the Drawings or as directed by the Engineer. It shall be the responsibility of the Contractor to furnish and install all proper size pipe bends for both horizontal and vertical deflections that are required to construct the pipeline to the line and grade as shown on the construction drawings or as set by the Engineer.

3.5 POLYETHYLENE ENCASEMENT

- A. The Contractor shall use Method A of ANSI/AWWA A21.5/C105 to install polyethylene encasement.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Test Pipe (other than air lines) per Section 40 05 13 – Common Requirements for Process Piping.
- C. Pressure Testing - Air
 1. All pressure pipelines conveying process air, flume air or primary air shall be tested by the Contractor in a manner satisfactory to and witnessed by the Engineer.
 2. The section under test shall be isolated by airtight plugs or valves from the air blowers and the diffuser headers which shall be tested separately.
 3. The pressure and leakage test shall first consist of filling the test section with compressed air to a pressure of 12 psig. The air inlet point shall be sealed and with no further introduction of air, the pipeline shall maintain a pressure of 12 psig for one hour. A pressure gage supplied by the Contractor and scaled to twice the test pressure shall be used to indicate the pressure.
 4. If the pipeline fails the above test, the Contractor shall locate and correct all leaks and retest the pipe section until it satisfactorily passes the test.

3.7 DISINFECTION OF POTABLE WATERLINES

- A. Following the testing procedure and after all corrections and adjustments have been made, all potable waterlines, both hot and cold-water systems, shall be disinfected in strict accordance with the following procedure:
1. Water shall be introduced with a chlorine concentration of at least 50 mg/L. Chlorine shall be added with either a solution feed chlorinator or a hypochlorite feeder. Chlorine application shall continue until the system is filled with the chlorine solution.
 2. The chlorinated water shall remain in the system for a minimum of 24 hr while all valves along the system are operated to insure their disinfection. Following the 24 hr period, a residual chlorine test shall be conducted on a fresh sample taken at a point farthest from the point the solution was introduced. If less than 25 mg/L of chlorine is indicated, the system shall be drained and the disinfection procedure repeated.
 3. After a chlorine residual of at least 25 mg/L is obtained, the system shall be flushed until the chlorine concentration is equal to or less than 1 mg/L.
 4. Disinfection shall conform to ANSI/AWWA C-651, latest revision. The Engineer and Owner shall be notified 48 hr in advance of the disinfection procedure. Also, the flushed solution shall be disposed of as directed by the Engineer and Owner.

END OF SECTION 40 05 19

40 05 51 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Valves.
2. Valve actuators.

B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves

C. Related Requirements:

1. Section 03 30 00 – Cast-in-Place Concrete
2. Section 05 50 00 – Metal Fabrications
3. Section 09 96 00 – High-Performance Coatings
4. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
3. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

B. ASTM International:

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. Manufacturers Standardization Society:

1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges, and Unions.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA:

1. NFPA 70 - National Electrical Code (NEC).

F. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

G. UL:

1. Equipment Directory.

1.3 COORDINATION

- A. Section 01 31 00 – Project Management and Coordination.
- B. Coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit manufacturer information for actuator with model number and size indicated.
 2. Submit valve cavitation limits.
- C. Shop Drawings: Indicate parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, and control system schematics.
- D. Valve Schedule: Indicating the service, size, and connections, make, model number and any special features such as chain wheel operators, etc.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Certification of Valves Larger than 12 Inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.
- H. Manufacturer Instructions: Submit installation instructions and special requirements.
- I. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.
- K. Qualifications Statement:
 1. Submit qualifications for manufacturer and licensed professional.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves and actuators.

1.6 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings and Shop Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- D. The manufacturer shall be required to furnish at the time of delivery an affidavit of compliance stating the valve and all materials used conform in every respect to the applicable performance of the appropriate AWWA Standard, and these supplementary specifications and that all tests have been performed with test requirements having been met. Test requirements shall be performed and test records furnished to the engineer prior to shipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum twenty years' documented experience

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Prepare valves and accessories for shipment according to latest edition of AWWA C500, Section 31 and:
 - 1. Seal valve ends to prevent entry of foreign matter into valve body.
 - 2. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.
- D. Store materials according to manufacturer instructions.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.

1.9 TOOLS AND SPARE PARTS

- A. Provide to the OWNER, one operating wrench for every 10 valves of each type (but not less than 2 wrenches per type), not equipped with hand wheels or levers.
- B. The manufacturer shall furnish any special tools necessary to disassemble, service, repair, and adjust the equipment.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

PART 2 - PRODUCTS

2.1 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.
- B. General:
 - 1. All packing, gaskets, discs, seats, diaphragms, lubricants, etc., shall conform to recommendations of the valve manufacturer for the intended service.
 - 2. All valves shall be manufacturer's standard of the design which the manufacturer recommends for the service intended.
 - 3. Each valve shall bear the maker's name or trademark or reference symbol to indicate the service conditions for which it is guaranteed.
 - 4. All valves for use with copper tubing shall have solder type connections.
 - 5. All screw end valves shall be threaded according to the American Standard for Pipe Threads No. B2.1.
 - 6. Flange end valves shall have connecting end flanges in accordance with the B16.1, Class 125 Series of the American Standards Association for type valves covered in the Standard, and in accordance with the Manufacturer's Standardization Society Standard Practice for bronze valves corresponding to the maximum pressure and service for which the valve is to be used.
- C. Valve Ends: Compatible with adjacent piping system.

D. Operation:

1. Open by turning counterclockwise; close by turning clockwise.
2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. Labeling: As specified in Section 40 05 53 - Identification for Process Piping.

F. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.
2. Bonnets:
 - a. Flanged to body and of same material and pressure rating as body.
 - b. Furnish glands, packing nuts, or yokes as specified in valve Sections.
3. Stems and Stem Guides:
 - a. Materials and Seals: As specified in valve Sections.
 - b. Bronze Valve Stems: According to ASTM B584.
 - c. Space stem guides 10 feet o.c.
 - d. Submerged Stem Guides: Type 304 stainless steel.
4. Nuts and Bolts: As specified in Section 05 50 00 - Metal Fabrications.

G. Valve Type:

1. Plug Valves: As specified in Section 40 05 62 – Plug Valves.
2. Ball Valves: As specified in Section 40 05 63 – Ball Valves.
3. Butterfly Valves: As specified in Section 40 05 64 – Butterfly Valves.
4. Swing and Disc Check Valves: As specified in Section 40 05 65 – Swing Check Valves.
5. Pressure-Regulating Valves: As specified in Section 40 05 66 – Pressure-Regulating Valves.
6. Pressure-Relief Valves: As specified in Section 40 05 67 – Pressure-Relief Valves.
7. Telescoping Valves: As specified in Section 40 05 71 – Telescoping Valves.
8. Mud Valves: As specified in Section 40 05 72 – Mud Valves.
9. Combination Air Valves for Wastewater Service: As specified in Section 40 05 78 – Combination Air Valves for Wastewater Service.

2.2 VALVE ACTUATORS

A. Description: Manual, pneumatic and electric motor actuators.

B. Provide actuators per specification Section 40 05 57 – Actuators for Process Valves and Gates

2.3 INSULATION

- A. As specified in Section 40 42 13 - Process Piping Insulation or as indicated on Drawings.

2.4 FINISHES

- A. Valve lining and coating: Comply with AWWA C550.
- B. Exposed Valves: As specified in Section 09 96 00 – High-Performance Coatings.
- C. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.
- C. Certificate of Compliance:
 - 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 – Project Management and Coordination: Requirements for installation examination
- B. Verify that piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Firmly support valves to avoid undue stresses on piping.
- C. Valves shall be installed with the stems positioned in the horizontal or above the centerline of the pipe unless otherwise shown on the Drawings.
- D. Operators shall be positioned so that they do not interfere with pedestrian traffic.

- E. Valve operators which are 7 ft 0 in. or more above the operating floor or platform shall be chain wheel operated.
- F. Where necessary for operations as described above, valves shall be bevel or spur gear operated. Plug valve 6 in. and larger shall be gear operated.
- G. Coat studs, bolts and nuts with anti-seizing lubricant.
- H. Clean field welds of slag and splatter to provide a smooth surface.
- I. Install valves with stems upright or horizontal, not inverted.
- J. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.
- K. All buried valves shall have a 2" operating nut and handwheels for all exposed valves.
- L. Install 3/4-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- M. Install valves with clearance for installation of insulation and to allow access.
- N. Provide access where valves and fittings are not accessible.
- O. Pipe Hangers and Supports: As specified in Section 40 05 07 - Hangers and Supports for Process Piping.
- P. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.
- Q. Install insulation as specified in Section 40 42 13 - Process Piping Insulation and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Valve Field Testing:
 - 1. Test for proper alignment.
 - 2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
 - 3. Architect/Engineer will witness field testing.

END OF SECTION 40 05 51

SECTION 40 05 53 - IDENTIFICATION FOR PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Division 40 – Process Interconnections
3. Division 43- Process Gas and Liquid Handling, Purification and Storage Equipment
4. Division 46 – Water and Wastewater Equipment

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color-coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit one tag, label, and pipe markers for each size used on Project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirement.

G. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials: Furnish one container of spray-on adhesive.
- C. Tools: Furnish special tools and other devices required for Owner to reinstall tags.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 1. Craftmark Pipe Markers
 2. Kolbi Pipe Marker Co.
 3. Seton Identification Products
 4. Or Approved Equal
- B. Description: Equipment nameplates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with oval head stainless steel screws or drive pins. Nameplates shall at a minimum contain manufacturers name and address, year of manufacture, serial number, speed (if applicable) and other applicable information.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
- b. Minimum Tag Size and Configuration: 1-1/2 inches; diameter or square.

B. Metal Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Aluminum or Stainless-steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 1-1/2 inches; diameter or square with finished edges.

C. Information Tags:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.
- d. Seton Identification Products
- e. Or Approved Equal

2. Description:

- a. Clear plastic with printed DANGER, CAUTION, WARNING, and message.
- b. Minimum Tag Size: 3-1/4 by 5-5/8 inch.
- c. Furnish grommet and self-locking nylon ties.

3. Tag Chart: Typewritten, letter-size list of applied tags and location, in anodized aluminum frame.

2.3 STENCILS

A. Manufacturers:

- a. Kolbi Pipe Marker Co.
- b. Seton Identification Products
- c. Or Approved Equal

B. Description:

1. Clean-cut symbols.
2. Letters:
 - a. Up to 2-inch Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 - b. 2-1/2- to 6-inch Outside Diameter of Insulation or Pipe: 1-inch-high letters.
 - c. Over 6-inch Outside Diameter of Insulation or Pipe: 1-3/4-inch-high letters

C. Stencil Paint: As specified in 09 96 00 - High-Performance Coatings; semigloss enamel.

D. Color-Coding and Lettering Size: Conform to ASME A13.1.

2.4 PIPE MARKERS

A. Color-Coding and Lettering Size: Conform to ASME A13.1.

B. Plastic Pipe Markers:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Seton Identification Products
- d. Or Approved Equal

2. Description:

- a. Factory-fabricated, flexible, semirigid plastic.
- b. Preformed to fit around pipe or pipe covering.
- c. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Manufacturers:

- a. Brady ID
- b. Craftmark Pipe Markers
- c. Kolbi Pipe Marker Co.

- d. Seton Identification Products
 - e. Or Approved Equal
- 2. Description: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Plastic Underground Pipe Markers:
 - 1. Manufacturers:
 - a. Kolbi Pipe Marker Co.
 - b. Seton Identification Products
 - c. Or Approved Equal
 - 2. Description:
 - a. Brightly colored, continuously printed plastic ribbon tape.
 - b. Minimum 6 inches wide by 4 mil thick.
 - c. Manufactured for direct burial service.

2.5 LABELS

- A. Manufacturers:
 - 1. Brady ID
 - 2. Seton Identification Products
 - 3. Or Approved Equal
- B. Description:
 - 1. Aluminum or Laminated Mylar construction.
 - 2. Minimum Size: 1.9 by 0.75 inches.
 - 3. Adhesive backed, with printed identification and bar code.

2.6 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Brady ID
 - b. Master Lock Company, LLC
 - c. Or Approved Equal
 - 2. Description:
 - a. Anodized aluminum or reinforced nylon construction.
 - b. Furnish hasp with erasable label surface.
 - c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

- a. Brady ID
- b. Master Lock Company, LLC
- c. Or Approved Equal

2. Description:

- a. Nylon or Steel construction.
- b. Furnish device preventing access to valve operator and accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 96 00 – High-Performance Coatings for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting as specified in Section 09 96 00 - High-Performance Coatings.
- B. Install identifying devices after completion of coverings and painting.
- C. Identify equipment with nameplates.
- D. Identify inline pumps and other small devices with tags.
- E. Identify control panels and major control components outside panels with plastic nameplates.
- F. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- G. Labels:
 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 2. For unfinished covering, apply paint primer before applying labels.
- H. Tags:
 1. Install tags using corrosion-resistant chain.
 2. Number tags consecutively by location.

- I. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- J. Identify valves in main and branch piping with tags.
- K. Piping:
 - 1. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers and/or stenciled painting.
 - 2. Use tags on piping 3/4-inch diameter and smaller.
 - 3. Identify service, flow direction, and pressure.
 - 4. Install in clear view and align with axis of piping.
 - 5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Ceiling Tacks:
 - 1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
 - 2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 40 05 53

SECTION 40 05 57 - ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual actuators.
2. Electric motor actuators.

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 96 00 - High-Performance Coatings
3. Division 40 - Process Interconnections

1.2 REFERENCE STANDARDS

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Water Works Association:

1. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.

C. NFPA:

1. NFPA 70 - National Electrical Code.

1.3 COORDINATION

A. Section 01 31 00 - Project Management and Coordination: Requirements for coordination.

B. Coordinate Work of this Section with installation of valves and accessories.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for actuator with model number and size indicated.

C. Shop Drawings:

1. Indicate parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, control system, and control system schematics on assembly drawings.
2. Submit actuator Shop Drawings with valve and gate submittal.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit special procedures and placement requirements.

F. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and types of actuators.

1.6 QUALITY ASSURANCE

A. Valve Actuators in NEC Class I, Group D, Division 1 for areas where flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.

B. Valve Actuators in NEC Class I, Group D, Division 2 for areas where flammable gases, vapors or liquids are not likely to exist under normal operating conditions.

C. Locations: Comply with NFPA 70.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 - 3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers:
 - 1. Dezurik
 - 2. Valmatic
 - 3. Approved Equivalent

2.2 DESCRIPTION

- A. Furnish gear and power actuators with position indicators.

2.3 MANUAL ACTUATORS

- A. Gate Valves: Gate valves shall be fitted with cast iron hand wheels of suitable size or gear and hand wheel operators in accordance with AWWA C500.

- B. Butterfly Valves: Butterfly valves 3 inches and smaller shall be lever and locking ratchet operated. Butterfly valves 4 inches and larger shall be equipped with gear and hand wheel operators. The operators shall be furnished by the manufacturer of the valve, in accordance with AWWA C504, who shall be responsible for the compatibility and adequacy of both the valve and operator. Valve operator shall be sized for the maximum torque developed by the maximum pressure in the pipeline in which the valve is to be used.
- C. Plug and Ball Valves: Plug and ball valves 3 inches and smaller shall be lever and locking ratchet operated. Plug and ball valves 4 inches and larger shall be provided with gear and hand wheel operators.
- D. Provide gear and power actuators with position indicators.
- E. Gear-Assisted Manual Actuators:
 - 1. Drive Type: Worm gear except where otherwise shown or specified
 - 2. Provide totally enclosed gears.
 - 3. Gearing: Designed for 100 percent overload.
 - 4. Bearings:
 - a. Type: Ball or Roller; comply with ABMA 9 or ABMA 11.
 - b. Permanently lubricated bronze.
 - c. Minimum L10 Life: 100,000 hours.
 - 5. Maximum Operating Force: 60 lbf.
 - 6. Handwheel: Minimum 12-inch diameter.
 - 7. Packing: Accessible for adjustment without requiring removal of actuator from valve.
- F. Chain Actuators:
 - 1. Description:
 - a. Chain actuators for shutoff valves mounted 7 feet and greater above operating floor level.
 - b. Chain guides and hot-dip galvanized operating chain extending to 5-1/2 feet above operating floor level.
 - 2. Chain Wheels: Sprocket rim type.
 - 3. Furnish chain storage if chains may interfere with pedestrian traffic.
- G. Buried Valves:
 - 1. Comply with AWWA C500.
 - 2. Floors:
 - a. Furnish extension stems to grade, and square nuts or floor stands with position indicators.
 - b. Cast-iron/Steel pipe extensions with valve boxes, covers, and operating keys.
 - c. Floor Boxes: Hot-dip galvanized cast iron or steel, with bronze cover.
 - d. Lid Inscription: An arrow at least 2" long showing direction of opening. The word OPEN shall also be cast on the flange.

3. Valve Boxes:

- a. Material: Cast iron.
- b. 12 Inch Diameter Valves and Smaller: Two-piece, screw type.
- c. Valves larger than 12 Inch Diameter: Three-piece, screw type.
- d. Lid Inscription: An arrow at least 2" long showing direction of opening. The word OPEN shall also be cast on the flange.

2.4 ELECTRIC MOTOR ACTUATORS

A. Manufacturers:

1. Auma Actuators, Inc.; Canonsburg, PA
2. Approved Equivalent

B. Description:

1. Motor, reduction gearing, torque switches, limit switches, auxiliary hand wheel, starter, mechanical position indicator, and accessories.
2. Comply with AWWA C542.
3. Open-close operation or modulation, as specified, or as shown on the Drawings.
4. Valve closing time will be 60 seconds, unless otherwise noted.
5. Actuators will be capable of operating in an ambient temperature range of -20 to +175 degrees F.
6. All actuators in open/close service will be furnished with integral, motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-off-remote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4~20 mADC signal from the controller and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail in the "open", "closed" or "last" position on loss of 4~20 mADC command signal.

C. Enclosure:

1. Minimum NEMA 250 Type 4. When specified, motor and all electrical enclosure shall be available to meet NEMA 6 submersible, or NEMA 7 hazardous requirements.
2. Mounting: Attached actuator housing using flanged motor adapter.

D. Motors:

1. As specified in Section 40 05 93 - Common Motor Requirements for Process Equipment.
2. Type:
 - a. Reversing or modulating, as specified, or as shown on the Drawings.
 - b. Totally enclosed, non-ventilated, high starting torque, low starting current.
 - c. Full-voltage starting.
3. Electrical Characteristics:

- a. Connections: As specified in Division 26 – Electrical.
- b. Torque: A running torque per valve manufacturer's recommendation.
- c. Sufficient horsepower to open or close a valve against the maximum specified differential pressure when voltage to the motor is $\pm 10\%$ of nominal voltage with a factor of safety of 1.5.
- d. Voltage: 480 V, three phase, 60 Hz.
- e. Lubrication: Pre-lubricated.
- f. Bearings Type: Anti-friction
- g. Motor Rating: 30 minute duty.

E. Reduction Gearing:

1. Description: Single- or double-reduction unit of spur or helical gears and worm-gearing.
2. Lubrication: Grease or oil.
3. Bearings:
 - a. Type: Ball or Roller; comply with ABMA 9 or ABMA 11.
 - b. Minimum L10 Life: 100,000 hours.

F. Limit Switches:

1. Type: Heavy duty, open contact.
2. Actuation: Rotor cam.
3. Compartment: Totally enclosed and equipped with a heater and thermostat to prevent build-up of moisture and contamination.
4. Switches shall be SPDT and rated 10A at 120 VAC or as specified.
5. Actuating Point: Adjustable at any point of valve between fully open and fully closed.
6. Adjustment: Capable of quick adjustment requiring no more than five (5) turns of the adjustment spindle.
7. Contacts: One set of normally open and one set of normally closed contacts will be furnished and available for use by the plant control system at each end of travel where indicated. Contact shall be of silver and capable of reliably switching a low voltage DC source from the control system furnished by other.

G. Torque Limiting Switches:

1. Torque limiting switches shall be provided.
2. Torque limiting switches shall be responsive to the mechanical torque developed in seating, backseating, or by obstruction.
3. Accuracy: Within $\pm 5\%$
4. Calibration: The use of torque wrenches for calibration shall not be required. Calibrated by use of a dynamometer in order to accurately predict the output of the actuator.
5. A calibration tag stating the maximum torque output of each torque switch at 100% setting shall be permanently affixed to the torque switch dial.

H. Hand Wheel Operation:

1. A permanently attached hand wheel shall be provided for emergency manual operation.
2. A seized or inoperable motor shall not prevent manual operation.
3. The hand wheel shall not rotate during electrical operation.
4. Maximum Torque Required: 60 lb-ft.

5. Maximum Force Required: 60 lbs.
6. Inscription: An arrow and either the word OPEN or CLOSE shall be cast in the hand wheel to indicate the direction to turn hand wheel.
7. Minimum Diameter: 8 inches.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assemblies.
- C. Certificate of Compliance:
 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

- A. Securely mount actuators using brackets or hardware specifically designed for attachment to valves.
- B. Extend chain actuators to 5-1/2 feet above operating floor level.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. After installation, inspect for proper supports and interferences.
- D. Repair damaged coatings with material equal to original coating as specified in Section 09 96 00 - High-Performance Coatings.

END OF SECTION 40 05 57

SECTION 40 05 59 - ALUMINUM SLIDE GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Aluminum slide gates.
- B. Related Requirements:
 - 1. Division 3 - Concrete
 - 2. Division 5- Metals
 - 3. Section 40 72 78 – Optical Rotary Shaft Encoders: for gates equipped with position transmitters.

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - 2. AWWA C542 - Electric Motor Operators for Valves and Slide Gates.
 - 3. AWWA C562 - Fabricated Aluminum Slide Gates.

1.3 COORDINATION

- A. Section 01 31 00 - Project Management and Coordination
- B. Coordinate Work of this Section with Work of other Sections.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product information for system materials and component equipment.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation and anchoring requirements, fasteners, and other details.
 - 3. Indicate gate identification number, location, service, type, size, design pressure, operator details, stem details, and loads.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1. Certify that installation is completed according to manufacturer's instructions.
 - E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
 - F. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
 - G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
 - H. Manufacturer Reports:
 1. Certify that equipment has been installed according to manufacturer's instructions.
 2. Indicate activities on Site, adverse findings, and recommendations.
 - I. Qualifications Statements:
 1. Submit qualifications for manufacturer and licensed professional.
- 1.5 CLOSEOUT SUBMITTALS
- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
 - B. Project Record Documents: Record actual locations of installed slide gates and components.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
 - B. Spare Parts:
 1. Furnish one set of manufacturer's recommended spare parts per gate provided.
 - C. Tools: Furnish special tools, wrenches, etc. and other devices required for Owner to maintain equipment.
- 1.7 QUALITY ASSURANCE
- A. Materials in Contact with Potable Water: Certified to NSF Standard 61 and NSF Standard 372.
- 1.8 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging, and inspect for damage.
- C. Store materials according to manufacturer's instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from areas involved in construction operations.
 - 2. Provide additional protection according to manufacturer's instructions.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after substantial completion date.
- C. Furnish five-year manufacturer's warranty that clear plastic stem covers will not crack, discolor, or become opaque.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Seating/Unseating Pressure:
 - 1. Measurement: From maximum water surface to centerline of gate.
- B. Minimum Vertical Loading: 50 percent of force on the gate from operating head acting on horizontal centerline of gate, multiplied by effective gate area, plus weight of slide and stem.
- C. Gate Reinforcement: As required for deflection not greater than 1/360 of span.
- D. Operating Head:

1. Safety Factor: Design gate to operate under specified operating head with safety factor of three.

2.2 ALUMINUM SLIDE GATES

A. Manufacturers:

1. Rodney Hunt
2. RW Gate Company
3. Or Approved Equal

B. Description:

1. Comply with AWWAC562.
2. Self-contained aluminum slide gate, with extended frame, stiffeners, yoke, lifting stem attached to yoke, lift and lift support, stem, stem guide, and stem block.
3. Non-self-contained aluminum slide gate, with limited frame, lifting stem, lift and lift support, stem, stem guide, and stem block.
4. Size, Operating Head, Closure and Opening are as indicated on Gate Schedule in Drawings.

C. Gates:

1. Configuration:

- a. One piece.
- b. Removable.

2. Material:

- a. Type 6061-T6 aluminum.
- b. Comply with AWWA C562.

3. Minimum Thickness: 1/4 inch.
4. Size: As indicated on Drawings.

D. Yokes:

1. Material: Structural steel.
2. Mounting: Bolted to gate frame.

E. Seats:

1. Impacted into dovetail slots and held in position without use of screws or other fasteners.
2. Maximum Clearance between Seating Faces: 0.004 inch when gate is fully closed.

F. Wedges:

1. Description: Machined brass blocks with angled faces and secured with a stud bolt to prevent slippage during operation.
2. Provide side, top, and bottom wedges.

G. Frames:

1. Configuration: One piece.
2. Material:
 - a. Type 6061-T6 extruded aluminum.
 - b. Comply with AWWA C562.
 - c. Bearing Bars: Ultra-high-molecular-weight polymer.
3. Mounting: As indicated on Drawings.
4. Minimum Thickness: 1/4 inch.
5. Liner: One-piece, extruded polymer channel or Neoprene rubber seal.
6. Bottom Flush Closure: Resilient seal securely attached to frame along invert.
7. Seals: Resilient J bulb.

H. Lifting Devices:

1. Description: Stem, lifting nut, supports, bushings, stem cover, position indicator, gear-assisted handwheel, handwheel, gear-assisted crank, crank, pneumatic actuator, hydraulic actuator and electric-motor actuator.
2. Mounting: Fabricated 304 stainless steel pedestal.
3. Powered Lift Devices:
 - a. As specified in Section 40 05 57 – Actuators for Process Valves and Gates.
 - b. Comply with AWWA C541 and AWWA C542.
4. Hand-Lifted Gates: Provide PVC grip for hand hold or stainless-steel lifting handle.

I. Handwheel:

1. Material: Cast aluminum.
2. Diameter: 18 inches, minimum.
3. Fully lubricated.
4. Configuration: Removable.
5. Mounting: Locate center of handwheel 36 inches above operating floor.

J. Lifting Nut:

1. Material: Brass.
2. Furnish grease fitting.
3. Furnish polymer bearing pads above and below lifting nut.

K. Lifting Stem:

1. General:
 - a. Stems shall be designed to transmit in compression a minimum of two times the rated output of the hoist at 40 lbs. effort on the crank or handwheel. The L/r ratio of the unsupported stem shall not exceed 200.
 - b. Stem guides, where required to limit the unsupported stem length, shall have a polymer or bronze bushings.

2. Material: Type 304 stainless steel.
3. Configuration:
 - a. Rising or Non-rising.
 - b. Removable.
4. Thread:
 - a. Acme, double lead.
 - b. Cut threads are not acceptable.
5. Fully lubricated.
6. Diameter: 1-1/8 inch
7. Maximum Number of Turns: 16 per foot of travel.
8. Stem Covers: Provide rising stem gates with clear polycarbonate or methacrylate plastic covers, capped, vented, and of a length to allow full travel of gate.

2.3 FINISHES

- A. Aluminum Surfaces: Mill finish.

2.4 ACCESSORIES

- A. Hardware: Type 316 stainless steel.
- B. Nameplates: As specified in Section 40 05 53 - Identification for Process Piping.
- C. Position Transmitters:
 1. Install optical rotary shaft encoders as specified in Section 40 72 78 on gates requiring position transmitters.

2.5 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assemblies.
- C. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facilities are ready to receive slide gates.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean surfaces according to manufacturer's instructions.

3.3 INSTALLATION

- A. Install slide gates according to manufacturer's instructions.
- B. Ensure that products are installed plumb, true, and free of warp or twist.
- C. Locate operators to avoid interference with handrails and other work.
- D. Guides:
 - 1. Surface and Flange Mounted:
 - a. Install guides with expansion anchors.
 - b. Position guides at elevation as indicated on Drawings.
 - 2. Recessed:
 - a. Cut slot in concrete to receive guides.
 - b. Position guides at elevation as indicated on Drawings.
 - c. Aluminum frames in contact with concrete or grout shall be coated with bitumastic.
 - d. Grout guides in place according to manufacturer's instructions.
- E. Sealant:
 - 1. Apply 1/8-inch-thick layer of elastomeric sealant to back of frame.
 - 2. Tighten nuts snug until sealant begins to flow beyond frame.
 - 3. Remove excess sealant.
 - 4. Cure sealant for minimum seven days.
 - 5. Tighten nuts to their final positions.
- F. Lubricants: Provide oil and grease as required for initial operation.

1. Lubricants shall be NSF approved or food grade quality.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection:
 1. Verify alignment of gate and components.
 2. Verify that gate operates smoothly and does not bind or scrape.
- C. Testing:
 1. Comply with AWWA C501.
 2. Leakage: Not exceeding 0.05 gpm/ft. of wetted seal perimeter in seating head and unseating head conditions
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) days on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:
 1. Adjust, repair, modify, or replace components failing to perform as specified and re-inspect.
 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust slide gates to provide smooth operation.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment operation, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 05 59

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Eccentric plug valves.
- B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves
- C. Related Requirements:
 - 1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C517 - Resilient-Seated Cast-Iron Eccentric Plug Valves.
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 4. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
- C. ASTM International:
 - 1. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES

- A. Manufacturers:
 - 1. Dezurik
 - 2. Mueller
 - 3. Or approved equal
- B. Description:
 - 1. Type:

- a. Non-lubricated.
 - b. Eccentric.
 - c. 90 Degree Turn
 - d. Resilient faced Plug
 2. Working Pressure: 175 psig for valves through 12" and 150 psig for valves for 14" through 72".
 3. Ports:
 - a. Configuration: Rectangular
 - b. Minimum Port Area: 100 percent of nominal pipe area for valves.
 4. Stem Bearings: Self-lubricating.
 5. Stem Seals:
 - a. Type: V-ring.
 - b. Material: Buna-N
 6. End Connections:
 - a. Flanged: Comply with ANSI 125/150 lb. Standard
 - b. Mechanical Joint
 - C. Operation:
 1. As specified in Section 40 05 57 Actuators for Process Valves and Gates.
 - D. Materials:
 1. Body:
 - a. Cast iron, ASTM A126 Class B.
 - b. Lining: As recommended by valve manufacturer for service conditions.
 2. Plug:
 - a. Cast iron, ASTM A126 Class B.
 - b. Lining: Buna N
 3. Seats: 1/8", welded, 90% pure Nickel
 4. Stem Bearings: Type 316L stainless steel.
 5. Seals: Buna-N.
 6. Connecting Hardware: Type 316 stainless steel.
 - E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.
- ## 2.2 SOURCE QUALITY CONTROL
- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
 - B. As specified in Section 40 05 51 - Common Requirements for Process Valves.

- C. Testing: Test gate valves according to AWWA C509.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves
- B. According to AWWA C517.
- C. Horizontal Piping: Stem horizontal.
- D. Vertical Piping: Plug at top when closed.
- E. Plugs: On top when open and on pressure side when closed.

END OF SECTION 40 05 62

SECTION 40 05 63 - BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal-seated ball valves.
2. Plastic ball valves (BA).

B. Conform to requirements of Section 40 05 51 – Common Requirements for Process Valves

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C507 - Ball Valves, 6 In. Through 60 In.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM D1784 - Standard Specification for Rigid PolyVinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
2. ASTM D3222 - Standard Specification for Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials.
3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

PART 2 - PRODUCTS

2.1 RUBBER-SEATED BALL VALVES

A. Manufacturers:

1. Henry Pratt Company; Aurora, IL
2. APCO
3. GA
4. Or approved equal

B. 4 Inches through 48 Inches:

1. AWWA C507, Class 150.
2. Body:
 - a. Material: Ductile iron, ASTM A536.
 - b. Seats: Rubber.
3. Ball:
 - a. Material: Cast iron, ASTM A126 or Ductile iron, ASTM A536.
 - b. Bearing Seal, O-Rings, and Packing: Buna-N.
4. Shaft and Attachment Pins: Type 316 stainless steel.
5. Bearings: PTFE-lined with fiberglass backing.
6. Shaft Seals: Self-lubricating and self-adjusting.
7. Connecting Hardware: Type 316 stainless steel.
8. End Connections:
 - a. Flanged: Comply with ASME B16.1.
9. Operator: Handwheel.

C. Smaller Than 4 Inches:

1. Comply with MSS SP 110.
2. Body:
 - a. Type: Two piece.
 - b. Material: Bronze.
3. Ball: Stainless steel.
4. Port: Full.
5. Seats: PTFE.
6. Stem: Blowout proof.
7. End Connections: Threaded, with union.
8. Operator: as scheduled
9. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.2 PLASTIC BALL VALVES

A. Manufacturers:

1. Asahi
2. Hayward
3. Or Approved Equal

B. Description:

1. Working Pressure: 232 psig at 68 deg. F.
2. Ports: Full size.
3. End Connections:
 - a. Socket Union
 - b. Threaded Pipe Union.

C. Operator: Manual unless otherwise specified or shown.

D. Materials:

1. Body and Ball: PVC, CPVC, PP as specified, shown on drawings, or recommended by the manufacturer for the service conditions specified.
2. Seats: PTFE.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- C. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves
- B. According to AWWA C507

END OF SECTION 40 05 63

SECTION 40 05 64 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rubber-seated butterfly valves.

B. Related Requirements:

1. Section 40 05 51 - Common Requirements for Process Valves

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C504 - Rubber-Seated Butterfly Valves.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM A536 - Standard Specification for Ductile Iron Castings.
2. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
3. ASTM D3222 - Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
4. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

PART 2 - PRODUCTS

2.1 RUBBER-SEATED BUTTERFLY VALVES

A. Manufacturers:

1. McWane-Clow (Series 4500 – Birmingham, AL
2. Henry Pratt Company; Aurora, IL
3. Mueller (Linesal III 3211) – Chattanooga, TN
4. DeZurik (AWWA C504) - Sartell, MN

B. Description:

1. Comply with AWWA C504, Class 150.
2. Minimum Working Pressure: 200 psig.
3. Shaft: Bearings shall be non-metallic and permanently lubricated.
4. Seats:
 - a. Mounting: On body for valves 24 inches and smaller.
 - b. Type: Field replaceable for valves larger than 30 inches.
5. Packing: V-type packing with a minimum of 4 sealing rings.
6. End Connections: Flanged end valves of short body design with 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges.

C. Operator:

1. As specified in Section 40 05 57 – Actuators for Process Valves and Gates
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: Cast iron, ASTM A126.
2. Stem: Stainless steel.
3. Disc: Cast iron, ASTM A48, Class 4C.
4. Seats:
 - a. Type: Resilient and replaceable.
 - b. Material: Buna N for water, or as required for other services
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings: Aluminum Bronze, ASTM B148, C954
7. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 09 96 00 – High-Performance Coatings.

2.2 BUTTERFLY VALVES FOR AIR SERVICE

A. Manufacturers:

1. Henry Pratt Company; Aurora, IL
2. DeZurik; Sartell, MN
3. Or approved equal

B. Description:

1. Comply with AWWA C504, Class 150.
2. Minimum Working Pressure: 175 psig.
3. Shaft: Bearings shall be non-metallic and permanently lubricated.
4. Seats:
 - a. Mounting: On body for valves 24 inches and smaller.

- b. Type: Field replaceable for valves larger than 30 inches.
- 5. Packing: V-type packing with a minimum of 4 sealing rings.
- 6. End Connections: Flanged end valves of short body design with 125 lb. flanged ends faced and drilled per ANSI B16.1 standard for cast iron flanges.
- C. Operator:
 - 1. As specified in Section 40 05 57 – Actuators for Process Valves and Gates
 - 2. Gear Actuators for Manual Valves: Comply with AWWA C504.
- D. Materials:
 - 1. Body: Cast iron, ASTM A126.
 - 2. Stem: Stainless steel.
 - 3. Disc: Cast iron, ASTM A48, Class 4C with welded nickel edge.
 - 4. Seats:
 - a. Type: Resilient and replaceable.
 - b. Material: EPDM for air service.
 - 5. Seating Surfaces: Type 316 stainless steel.
 - 6. Bearings: Aluminum Bronze, ASTM B148, C954
 - 7. Connecting Hardware: Type 316 stainless steel.
- E. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 40 05 51 - Common Requirements for Process Valves.
- C. Testing: Test butterfly valves according to AWWA C504.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves
- B. According to AWWA C504.

END OF SECTION 40 05 64

SECTION 40 05 65.23 - SWING AND DISC CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Swing check valves three (3) inches and larger.

B. Conform to the requirements of Section 40 05 51 – Common Requirements for Process Valves.

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm through 600-mm) NPS.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.

PART 2 - PRODUCTS

2.1 STANDARD SWING CHECK VALVES

A. Manufacturers:

1. Clow
2. Or approved equal

B. Description:

1. Comply with AWWA C508.
2. Swing check valves shall be used for water and wastewater service.
3. Check valves used for air service shall be provided by the biological process supplier.
4. Minimum Working Pressure: 200 psig for 2" - 12" and 150 psig for 14" - 30"
5. Type: Swing, resilient seated with outside lever and adjustable weight.
6. Mounting: Horizontal or vertical.
7. End Connections: Integral flange ends shall be ANSI B16.1 Class 125, suitable for horizontal or vertical installation.

C. Materials:

1. Body and Cover: Ductile iron, ASTM A536.
2. Disc, Disc Arm: Ductile iron, ASTM A536.
3. Body Seat: Replaceable, Type 316 ASTM A276 with Buna-N renewable seat ring.
4. Shaft: Type 303 Stainless Steel ASTM A582.
5. Disc Seat: Buna-N.
6. Lever and Counterweight: Ductile Iron, ASTM A536.
7. Hinge Pin and Key: Type 316 Stainless Steel.
8. Rubber Components: Buna-N.
9. Connecting Hardware: Type 304 Stainless Steel.

D. Finishes: As specified in Section 40 05 51 - Common Requirements for Process Valves.

E. .

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

A. As specified in Section 40 05 51 - Common Requirements for Process Valves.

B. According to AWWA C508.

END OF SECTION 40 05 65.23

SECTION 40 05 67.36 - PRESSURE-REGULATING VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure-reducing valves (PRV).

B. Conform to the requirements of Section 40 05 51 - Common Requirements for Process Valves

C. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA C530-12 – Pilot-Operated Control Valves

B. ASME International:

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.

C. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

D. American Water Works Association:

1. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

PART 2 - PRODUCTS

2.1 PRESSURE-REDUCING VALVES

A. Manufacturers:

1. Cla-Val.
2. Flomatic Corporation
3. Singer Valve
4. Or Approved Equal.

B. Description:

1. Normally open or closed valves to maintain constant downstream pressure regardless of changing flow rate or varying inlet pressure, and to prevent backflow.
2. Type: Pilot operated.
3. Furnish V-ports for pressure control at low flows.
4. Indicator Rod: Attached to piston for visual position indication.

C. Pilot Valves:

1. Type: Globe or Angle
2. Body: Cast iron, Ductile iron, Steel, or Stainless steel.

D. End Connections:

1. Flanged, ASME B16.5 or B16.42, Class 150.

E. Performance and Design Criteria:

1. Flow Rate: as shown on drawings.
2. Maximum Upstream Pressure: 200 psig
3. Set Point Downstream Pressure:
 - a. As indicated on Drawings.
 - b. Range: Field adjustable from near zero to 110 percent.

F. Materials:

1. Body: Cast iron, ASTM A126, Class B or Ductile iron, ASTM A536
2. Disc and Diaphragm:
 - a. Buna-N rubber.
 - b. Disc Retainer and Diaphragm Washer: Cast iron or Cast steel or Bronze
3. Trim: Bronze or Stainless steel
4. Stem, Nut, and Spring: Stainless steel
5. Packing: PTFE
6. Control Piping: Brass or Bronze with stainless-steel wetted trim.

- G. Interior Coating: Coat cast-iron and ductile-iron surfaces with epoxy coating according to AWWA C550.
- H. Accessories:
 - 1. Externally mounted strainer with cocks.
 - 2. Isolation valve.
 - 3. Check valves.
 - 4. Low-flow bypass.
 - 5. Position Indicator
 - 6. Inlet and Outlet Pressure Gauges

PART 3 - EXECUTION

3.1 EXAMINATION, INSTALLATION AND FIELD QUALITY CONTROL

- A. As specified in Section 40 05 51 - Common Requirements for Process Valves
- B. According to AWWA C530-12.

END OF SECTION 40 05 67.36

SECTION 40 05 78 - COMBINATION AIR VALVES FOR WASTEWATER SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Combination air valves for wastewater treatment facilities.
- B. Related Requirements:
 - 1. Section 09 96 00 - High Performance Coatings
 - 2. Division 40 - Process Interconnections

1.2 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
- B. ASME International:
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASTM International:
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
- D. International Organization for Standardization:
 - 1. ISO 9001 - Quality Management Systems.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WASTEWATER SERVICE

- A. Manufacturers:
 - 1. DeZurik.
 - 2. A.R.I
 - 3. H-TEC
 - 4. Approved Equivalent

B. Description:

1. Type:

- a. Automatic, float operated.
- b. Body: Single.

2. Comply with AWWA C512.

3. Size: As indicated on Drawings.

4. Suitable for sewage service.

C. Materials:

- 1. Body and Cover: Stainless steel with stainless steel screws, unless indicated in the plan set.
- 2. Float, Seat, and Trim: Stainless steel.
- 3. Seats: Buna-N.
- 4. Seals: Buna-N.

D. End Connections - Single Body:

1. Size 4 Inches and Smaller:

- a. Threaded, NPT.
- b. 1-Inch Valves: Furnish 2-inch inlet.

2. Backwash Accessories: NPT connections.

E. Valve Body Connections:

- 1. Threaded, NPT.
- 2. Cleanout: 2 inches.
- 3. Drain: 1 inch.

F. Accessories:

- 1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.

2.2 INSULATION

- A. As specified in Section 40 42 13 - Process Piping Insulation.

2.3 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 09 96 00 - High-Performance Coatings.

2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Certificate of Compliance:
 - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Inspect for interferences and proper supports.
- D. Testing:
 - 1. As specified in Section 40 05 51 - Common Requirements for Process Valves.
 - 2. Demonstrate operation without undue noise or vibration.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
 - 3. Repair damaged coatings with material equal to original coating.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

END OF SECTION 40 05 78

SECTION 40 41 13 - PROCESS PIPING ELECTRICAL RESISTANCE HEAT TRACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Self-regulating cables.
2. Heat-tracing controls.

B. Related Requirements:

1. Section 26 00 00 - Electrical: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 40 05 13 - Common Work Results for Process Piping: Piping components, appurtenances, and identification requirements common to process piping systems.
3. Section 40 05 53 - Identification for Process Piping: Labels as required by this Section.

1.2 DEFINITIONS

- A. Self-Regulating Index (SRI): The rate of change of power output in Watts per degree F, as measured between the temperatures of 50 degrees F and 100 degrees F.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM B193 - Standard Test Method for Resistivity of Electrical Conductor Materials.
2. ASTM D2633 - Standard Test Methods for Thermoplastic Insulations and Jackets for Wire and Cable.

B. FM Global:

1. FM Approval Guide.

C. International Electrotechnical Commission:

1. IEC 216-1 - Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials - Part 1: General Procedures for the Determination of Thermal Endurance Properties, Temperature Indices and Thermal Endurance Profiles.
2. IEC 60800 - Heating cables with a rated voltage of 300/500 V for comfort heating and prevention of ice formation.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 V Maximum).

E. National Fire Protection Association:

1. NFPA 70 - National Electrical Code (NEC).

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's product data for system materials and component equipment, including thermal properties, electrical characteristics, and connection requirements.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1. Certify installation is completed according to manufacturer's instructions.

E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.

H. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations of piping receiving heat tracing and locations of source power and controls.

C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept heat tracing on-Site in original packaging. Inspect for damage.
- D. Store heat tracing and components according to manufacturer's instructions.
- E. Protect heat tracing from water and wet weather.

1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five (5) year manufacturer's warranty for heat tracing and components.

PART 2 - PRODUCTS

2.1 SELF-REGULATING CABLE

- A. Manufacturers:
 - 1. RayChem; Spring, TX
 - 2. Thermon; San Marcos, TX
 - 3. Approved Equal.
- B. Description:
 - 1. Bus Wires: Two, parallel; nickel-coated copper; minimum size 16 AWG.
 - 2. Heating Element: Self-regulating polymeric core.
 - 3. Jacketing:
 - a. Tinned copper braid with resistance less than cable bus wire resistance, as determined by ASTM B193.
 - b. Fluoropolymer insulating jacket.
 - 4. Cable Temperature Identification Number (T-Rating): T6, without use of thermostats; according to NEC.
 - 5. Output: As indicated on Drawings; minimum 3 W/ft.
- C. Performance and Design Criteria:
 - 1. Power output varies relative to the temperature of surface of pipe or appurtenance.
 - 2. Cable can be crossed over itself and cut to length at Site.
 - 3. Minimum SRI:

- a. Cable Rating 3 W/ft.:
 - 1) SRI: 0.038 W/degree F.

D. Operation:

- 1. Electrical Characteristics: According to Section 26 05 03 - Equipment Wiring Connections and following:
 - a. Voltage: 120V, single phase, 60 Hz.
 - b. Furnish ground-fault protection device set at 30 mA, with nominal 100-ms response time, to protect each circuit.
- 2. Disconnect Switch: Factory mounted in control panel.

E. Accessories:

- 1. Approved for the respective area classification and approved as a system with the particular type of heating cable in use.
- 2. Splicing connectors.
- 3. End terminations.
- 4. T-connectors.
- 5. Power termination kits.

2.2 HEAT-TRACING CONTROLS

A. Control and Monitoring Panel:

- 1. Materials: Nonmetallic.
- 2. Rating: NEMA 4X.
- 3. Configuration: Wall or Pedestal mounted.
- 4. Temperature Controller: Microprocessor based; diagnostic self-testing capability.
- 5. Communications Port: Modbus ASCII via RS 485.
- 6. ON-OFF Control: Soft start.
- 7. Real-Time Data Indication:
 - a. Temperature.
 - b. Heater current.
 - c. Ground leakage current.
- 8. Stored Data:
 - a. Highest temperature encountered.
 - b. Lowest temperature encountered.
- 9. Alarms:
 - a. LOW TEMPERATURE.
 - b. HIGH TEMPERATURE.
 - c. LOW HEATER CURRENT.
 - d. HIGH HEATER CURRENT.

- e. GROUND LEAKAGE CURRENT.
- f. DAMAGED RTD SENSOR.

B. Single Thermostat:

- 1. Description: Stainless-steel remote bulb with 6-foot capillary encased in flexible stainless-steel armor.
- 2. Housing: FM-approved, NEMA 4X.
- 3. Set-Point Range: 35 to 235 degrees F

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Testing:

- 1. Conform to IEC 216-1 for following:
 - a. Retain at least 75 percent of rated power after 20 years of operation at maximum published continuous exposure (maintain) temperature.
 - b. Retain at least 90 percent of rated power after 1,000 hours of operation at maximum published intermittent exposure temperature.
- 2. Cable Dielectric Test: Passing 2.5 kV dielectric test for one minute according to ASTM D2633 after undergoing a 0.5 kg-m impact according to IEC 60800.
- 3. Before shipment, demonstrate cable insulation resistance of 20 megohms minimum bus to braid using a 2,500-V DC megger, and demonstrate tolerance for one minute at voltage equal to twice rated plus 1,000 V applied bus to braid.
- 4. Thermal Runaway:
 - a. Ensure that cable produces less than 0.5 W/ft. when energized and heated to 350 degrees F for 30 minutes.
 - b. After testing and reenergizing, demonstrate that cable does not have an increasing power output leading to thermal runaway.

C. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

- 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

- B. Verify that surfaces of pipes, valves, and fittings are clean and dry.
- C. Verify that piping has been inspected and is ready for insulation.

3.2 INSTALLATION

- A. Install heat tracing before insulation is installed.
- B. Install equipment according to manufacturer's instructions.
- C. If required, spiral heat-trace cable around piping to obtain proper heating per length of piping.
- D. Do not overlay cable over cable.
- E. Cover installed heating cable with thermal insulation and waterproof jacketing as soon as possible.
- F. Affix following label, as specified in Section 40 05 53 - Identification for Process Piping, to exterior of thermal insulation every 15 feet and readily visible from ground level: ELECTRIC HEAT TRACING: CAUTION.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. After installation, inspect for proper operation.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust and check control module functions.
- C. Check thermostat and wiring connections to heater cable.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 41 13

SECTION 40 42 13 - PROCESS PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Process piping insulation.
2. Jacketing.
3. Accessories.

B. Related Requirements:

1. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
3. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
6. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
7. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
8. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
9. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
10. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
11. ASTM C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
12. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
13. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
14. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
15. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.

16. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
17. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
18. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
19. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
20. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
21. ASTM D1785 - Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120.
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-69 - Pipe Hangers and Supports - Selection and Application.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product description, thermal characteristics, list of materials, and thickness for each service and location.
- C. Manufacturer's Instructions: Submit manufacturer's published literature indicating recommended installation procedures.

1.4 QUALITY ASSURANCE

- A. Comply with ASTM C585 for inner and outer diameters of pipe insulation.
- B. Factory-fabricated fitting covers according to ASTM C450.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on-Site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Inspection: Accept insulation on-Site in manufacturer's packaging. Inspect for damage.
- D. Store insulation according to manufacturer's instructions.

- E. Protect insulation from weather and construction traffic, dirt, water, chemicals, and damage by storing in original wrapping.

1.6 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Install insulation only when ambient temperature and humidity conditions are within ranges as recommended by manufacturer.
- C. Maintain recommended temperature and humidity before, during, and after installation for minimum of 24 hours.

1.7 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- A. Type P-1:
 - 1. Description: Molded glass fiber.
 - 2. Comply with ASTM C547. Comply with ASTM C795 for application on austenitic stainless steel.
 - 3. Thermal Conductivity: 0.23 Btu-in./h-ft.-deg. F at 75°F.
 - 4. Operating Temperature Range: Zero to 850°.
 - 5. Vapor Barrier Jacket:
 - a. Description: Factory-applied, reinforced foil kraft with self-sealing adhesive joints.
 - b. Comply with ASTM C1136, Type I.
 - 6. Jacket Temperature Limits: Minus 20 to 150°F.
- B. Type P-5:
 - 1. Description:

- a. Flexible, closed-cell elastomeric.
 - b. Tubular.
2. Comply with ASTM C534, Type I.
3. Thermal Conductivity: 0.27 Btu-in./h.-ft.-deg. F at 75°.
4. Operating Temperature Range: Minus 70 to 180 °F.

2.2 PIPE INSULATION JACKETS

A. PVC Plastic Pipe Jacket:

1. Description:
 - a. One-piece, molded-type fitting covers and sheet material.
 - b. Color: Off-white.
2. ASTM D1785.
3. Thickness: 15 mils.
4. Connections: Brush-on welding adhesive.

B. Acrylonitrile Butadiene Styrene (ABS) Plastic Pipe Jacket:

1. Description:
 - a. One-piece, molded-type fitting covers and sheet material.
 - b. Color: Off-white.
2. Minimum Service Temperature: Minus 40°F.
3. Maximum Service Temperature: 180°F.
4. Water Vapor Permeance:
 - a. ASTM E96.
 - b. 0.02 perms.
5. Thickness: 30 mils.
6. Connection: Brush-on welding adhesive.

C. Stainless-Steel Pipe Jacket:

1. Comply with ASTM A240 or ASTM A666.
2. Material: Type 304 stainless steel.
3. Thickness: 0.016 inch.
4. Finish: Smooth.
5. Metal Jacket Bands:
 - a. Width: 3/8 inch.
 - b. Thickness and Material: 0.020 inch, stainless steel.

2.3 PIPE INSULATION ACCESSORIES

- A. Closed-Cell Elastomeric Insulation Pipe Hangers:
 - 1. Description: Polyurethane insert with stainless-steel jacket single-piece construction and self-adhesive closure.
 - 2. Thickness: Match pipe insulation.
- B. Tie Wire: 0.048-inch stainless steel with twisted ends on maximum 12-inch centers.
- C. Adhesives: Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that piping and equipment has been tested before applying insulation materials.
- C. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Fire-Rated Penetrations:
 - 1. Continue insulation through penetrations of building assemblies or portions of assemblies having fire-resistance rating of one hour or less.
 - 2. Provide intumescent firestopping when continuing insulation through assembly.
 - 3. Finish at supports, protrusions, and interruptions.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies and expansion joints.
 - 2. Jacketing:
 - a. Furnish factory-applied or field-applied vapor-retarder jackets.
 - b. Secure factory-applied jackets with pressure-sensitive adhesive with self-sealing longitudinal laps and butt strips.
 - c. Secure field-applied jackets with outward-clinch expanding staples, and seal stapled penetrations with vapor-retarder mastic.
 - 3. Fittings, Joints, and Valves:

- a. Insulate with molded insulation of like material and thickness as adjacent pipe.
- b. Finish with glass cloth and vapor-retarder adhesive or PVC fitting covers.

D. Glass-Fiber Board Insulation:

1. Apply insulation close to equipment by grooving, scoring, and beveling insulation.
2. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
3. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface; on cold equipment, use vapor-retarder cement.
4. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.

E. Inserts and Shields:

1. Piping 1-1/2 Inch Diameter and Smaller: Install stainless steel shield between pipe hanger and insulation.
2. Piping 2-Inch Diameter and Larger:
 - a. Install insert between support shield and piping, and under finish jacket.
 - b. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - c. Insert Material: Compression-resistant insulating material suitable for planned temperature range and service.
3. Piping Supported by Roller-Type Pipe Hangers: Install stainless steel shield between roller and inserts.

F. Closed-Cell Elastomeric Insulation:

1. Push insulation onto piping.
2. Miter joints at elbows.
3. Seal seams and butt joints with manufacturer's recommended adhesive.
4. If application requires multiple layers, apply with staggered joints.
5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.

G. High-Temperature Pipe Insulation:

1. Install in multiple layers to meet scheduled thickness.
2. Attach each layer with bands, securing first layer with bands before installing next layer.
3. Stagger joints between layers.
4. Cover with stainless-steel jacket with seams located on bottom side of horizontal piping.

H. Piping Exposed in Equipment Rooms or Finished Spaces (less than 10 feet above Finished Floor): Finish with PVC jacket and fitting covers or ABS jacket and fitting covers.

I. Piping Exterior to Building:

1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass-mesh-reinforced, vapor-retarder cement.
2. Cover with stainless-steel jacket with seams located at 3- or 9-o'clock position on side of horizontal piping, with overlap facing down to shed water, or on bottom side of horizontal piping.

J. Buried Piping:

1. Insulate only where insulation manufacturer recommends insulation product may be installed in trench or tunnel, or direct buried.
2. Install factory-fabricated assembly with inner all-purpose service jacket, with self-sealing lap, and asphalt-impregnated open-mesh glass fabric with 1-mil-thick aluminum foil sandwiched between three layers of bituminous compound.
3. Face outer surface with polyester film.

K. Heat-Traced Piping Interior to Building:

1. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe.
2. Size large enough to enclose pipe and heat tracing.

L. Heat-Traced Piping Exterior to Building:

1. Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe.
2. Size insulation large enough to enclose pipe and heat tracing.
3. Cover with stainless-steel jacket with seams located at 3- or 9-o'clock position on side of horizontal piping, with overlap facing down to shed water.

M. Prepare pipe insulation for finish painting as specified in Section 09 96 00 – High-Performance Coatings.

3.3 ATTACHMENTS

A. Process Piping Insulation Schedule:

1. Potable and Non-potable Water (where exposed):
2. Chemical Feed Piping (where exposed)
 - a. Type P-1 or P-5.
 - b. Thickness:
 - 1) Pipe Sizes 1-1/4 Inches and Smaller: 1/2 inch.
 - 2) Pipe Sizes 1-1/2 Inches and Larger: 1 inch.

END OF SECTION 40 42 13

SECTION 40 70 23 – PROCESS CONTROL NARRATIVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Process control narratives for multiple treatment facility processes.
- B. Related Requirements:
 - 1. Division 26 – Electrical
 - 2. Division 43 – Process Gas and Liquid Handling, Purification, and Storage Equipment
 - 3. Division 46 – Water and Wastewater Equipment

1.2 REFERENCES

- A. International Society of Automation (ISA)
- B. National Institute of Standards and Technology (NIST)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

1.4 FAULT RESPONSE

- A. Communication Failure
 - 1. In the event of a communication failure between a PLC and the HMI, the continued operation of the equipment will depend on the equipment control mode prior to the communications failure, as defined below:
 - a. If the equipment was operating in REMOTE-AUTO mode prior to the communications failure, the PLC will continue to operate the equipment based on the Operators defined process setpoints. The state of the equipment can be changed if the Operator switches the equipment to LOCAL mode at the equipment's local control panel and start/stops equipment, using field mounted controls.
 - b. If the equipment was operating in REMOTE-MANUAL mode prior to the communications failure, the equipment will revert to REMOTE-AUTO mode upon loss of communication continuing operation, using the last known setpoints.
 - c. If the equipment was operating in LOCAL-MANUAL mode, it is the Operator's responsibility to manually operate this device or place it back into REMOTE-AUTO or it will not function via PLC control.
 - d. When running in LOCAL-MANUAL mode, the device will continue operating in its current state (running/stopped) until a hard-wired interlock stops the equipment.
 - 2. An alarm will be displayed at the HMI, indicating the failed communication link.
- B. Equipment Failure

1. In the event of a plant power failure, the SCADA will store the active setpoints and duty statuses, allowing the Operator to restart the plant with the prior configuration.
2. Any failed equipment will issue an alarm. In most cases, level transmitters will defer operation of designated pumps to associated float bulbs. Vendor package control panels that lose communication with their parent PLC will trigger a communication alarm, and continue to operate locally, if possible.
3. In the event of a level transmitter failure, the PLC will force the level sensor value to 0 (empty well reading) and a transmitter failure alarm will be displayed at the HMI.
4. All other transmitter failures will result in an alarm being displayed at the HMI. The transmitter will need to be inspected and repaired.
5. An actuator fault can be a jam, electrical fault, or loss of communication. In motors, additional faults are overcurrent, leakage, over-speed, and/or vibration.
6. Most actuators (particularly gate actuators) are configured to remain in their current position in the event of a fault. In most cases this will allow the current duty device to continue operating, while giving the Operator enough time to attend to the faulted actuator, and shut down the related process equipment, if necessary. In many cases, this means gates are failing to the open position.
7. By failing to the open position, gates are less likely to cause upstream flooding under normal flow conditions. However, if pipes are damaged or clogged, preventing proper flow, flooding may occur in the event of a fault.

C. Interlocks

1. Safety interlocks are designed to prevent damage to equipment and injury to plant personnel. Hard-wired interlocks, such as high temperatures and pump overloads will stop the equipment and prevent it from running, until the alarm condition has been reset in the field. Software (PLC generated) interlocks, such as pump watchdogs or valve failure alarms, must be reset by the Operator at the HMI, before the equipment is allowed to be operated again in any REMOTE mode.
2. Any alarm listed in this document's alarm tables, containing a reset location of Field, indicates it is a hardwired interlock, while any alarm with a reset location of SCADA, indicates it is a software interlock.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 HEADWORKS (PID I-101)

A. Influent screening modifications include:

1. Two (2) new Bar Screens (SCR1010, and SCR1020)
2. One (1) new Screenings Washing & Compactor (SWC 1040)

B. The pumps are controlled from the HMI, LCP1000, and the SCADA system.

3.2 PRIMARY TREATMENT (PID I-201)

A. Primary treatment modifications include:

1. One (1) new electromagnetic flow meter (FE 2034)

B. This device will be utilized to measure incoming industrial flow.

C. Main Flow Splitter (I-201)

1. General:

The Primary Effluent flow from the Headworks (FE/FIT1250A, FE/FIT1250B) plus the industrial flow from the 16" industrial forcemain (FE/FIT 2034) flow into the Main Flow Splitter and is split proportionally to the Aeration Basins (T3010, T3020, & T3030) in service over electric actuated weirs of equal length. Electric actuated downward opening weir gates (SG2031, GG2032 & SG2033) may be positioned to prevent flow over a weir to a Aeration Tank. Each slide gate is equipped with a linear position transmitter (ZT2031B, ZT3032B & ZT2033B) to determine the weir position relative to the level in the splitter box measured by (LE/LIT2030). This will allow the flow to each basin to be measured by each weir independently.

- a. Manual: the weir will be set at the operator set flow rate
- b. Auto: Each weir operate on PID control to achieve a proportional split to each active aeration basin with Aeration Basin No. 1 being the last basin adjusted unless it is off-line.

3.3 RAS SYSTEM FLOW CONTROL (PID I-301, I-401, I-402, I-403)

A. RAS modifications include:

1. General:

A set of twelve (12) RAS pumps (two for each clarifier) and six strap-on ultrasonic flow meters (Clarifier #1 FE/FIT4100, P4111/P4112, Clarifier #2 FE/FIT4200, P42111/P4212, Clarifier #3 FE/FIT4300, P4311/P4312, Clarifier #4 FE/FIT4400, P4411/P4412, Clarifier #5 FE/FIT4500, P4511/P4512, Clarifier #6 FE/FIT4600, P4611/P4612) draw settled sludge from the bottom of the clarifiers and pump it into the common RAS header. The RAS pumps are equipped with variable frequency drive (VFD) motors to adjust the pump speed/flow rate.

All RAS pumps discharge into a common RAS pipe. RAS flow to each Aeration Tank is controlled by magnetic flow meters and electric actuated flow control valves at each Aeration Basin. The RAS pump motor speed will receive a signal from SCADA based on the total RAS demand. The flow from the RAS pumps will adjust according to the flow meter output which will be either preset or flow paced from SCADA, based on the total RAS demand. The electrically actuated valves downstream of each flow meter will modulate based on the signal relayed from the associated flow meter to achieve the required flow rate. The flow rate to each basin will be a function of the basin volume.

Each clarifier will have an ENABLE/DISABLE switch in SCADA that will designate a clarifier as in service or out of service. Each clarifier will be interlocked with the two corresponding pumps. If the clarifier is disabled, the corresponding pumps will be placed out of service and the remaining RAS rate will be divided by the enabled clarifiers.

2. Three (3) new rate of flow controllers for RAS (V3001, V3002, and V3003)
 3. Three (3) new electromagnetic flow measuring devices (FE3010, FE3020, and FE3030)
- B. The purpose of the rate of flow controllers is to deliver RAS in a metered fashion to each of the three (3) Aeration Basins.
1. Local: the RAS valves can be positioned as desired by the operator. On loss of power the RAS valves will hold the last position.
 2. Remote: the RAS valves will be positioned by flow controllers FC 3010, FC3020 and FC 3030. Actual RAS flow rate to each tank is determined by (FE3010, FE3020, and FE3030). The individual tank RAS flow rates are summed at the SCADA level to give a total process RAS flow. A SCADA based PID valve position controller will modulate each RAS valve to achieve the desired RAS flow split. SCADA will also monitor the position of each valve. On loss of control signal or power the RAS valves will hold the last position.

3.4 TERTIARY FILTRATION (PID 1-501)

- A. General
1. A set of two (2) tertiary disc filters (DF5100, DF 5200) will operate to remove settleable solids, foam, and floatable scum that remain in the clarifier overflow. The filters are disc cloth fiber type and operate independently of each other. Flow is directed to the filter structure via a 48" pipe which enters the central channel from which flow into a particular filter is controlled by an influent gate (SG5100, SG5200). The water flows through the stationary filter discs into the filter containment area and then over a fixed weir into a filter effluent trough. Filter control is via a PLC in each filter vendor supplied control panel. SCADA provides indication and recording of run and fault status for filter drive motors and backwash pumps. A pressure switch (PT5111/PT5211) is interlocked with the backwash pump to prevent/stop it from running if a high discharge pressure is detected.
- B. Control: Control of the tertiary filters shall be via the local control panel with status relayed to the plant SCADA.
1. Local Manual:
 - a. A Call to Run from the filter control panel (FCP5100, FCP5200) for the filter motor (DF5100, DF5200) and the backwash pump (P5100, P5200) shall rotate the filter on its shaft and start the backwash pump, respectively, to initiate a backwash sequence. Backwash should only be initiated if at one (1) backwash suction line valve is open.
 - b. When a backwash is initiated, backwash valves shall be opened corresponding to the discs being backwashed as follows:
 - 1) DF5100 Discs 1-8: V5105
 - 2) DF5100 Discs 9-16: V5106
 - 3) DF5100 Solids Removal: V5104
 - 4) DF5200 Discs 1-8: V5205

- 5) DF5200 Discs 9-16: V5206
 - 6) DF5200 Solids Removal: V5204
2. Local Auto:
 - a. Backwash shall be initiated when water reaches the elevation set at the filter control panel (FCP5100, FCP5200) based on level elements (LE/LT5110, LE/LT5210) prompting filter motor (DF5100, DF5200) to rotate on its shaft and backwash pump (P5100, P5200) to start. Upon backwash initiation, filter PLC shall open backwash valve corresponding to discs being backwashed.
 - b. Floatable solids/scum removal
 - 1) At a set interval, the water level in filter (DF5100, DF5200) shall be allowed to rise above the scum weir elevation for a set duration to remove floatable solids and/or scum. Following the set duration, backwash should be initiated to lower water elevation back to a normal level.
3. Remote Manual:
 - a. A Call to Run from the SCADA system for the filter motor (DF5100, DF5200) and the backwash pump (P5100, P5200) shall rotate the filter on its shaft and start the backwash pump, respectively, to initiate a backwash sequence. Backwash should only be initiated if at one (1) backwash suction line valve is open.
 - b. When a backwash is initiated, backwash valves shall be opened corresponding to the discs being backwashed as follows:
 - 1) DF5100 Discs 1-8: V5105
 - 2) DF5100 Discs 9-16: V5106
 - 3) DF5100 Solids Removal: V5104
 - 4) DF5200 Discs 1-8: V5205
 - 5) DF5200 Discs 9-16: V5206
 - 6) DF5200 Solids Removal: V5204
4. Remote Auto:
 - a. Backwash shall be initiated when water reaches and remains for a specified delay duration above a high setpoint the elevation set at the filter control panel (FCP5100, FCP5200) based on level elements (LE/LT5110, LE/LT5210) prompting filter motor (DF5100, DF5200) to rotate on its shaft and backwash pump (P5100, P5200) to start.. Upon backwash initiation, filter PLC shall open backwash valve corresponding to discs being backwashed. The backwash shall last for a specified time or until the water level in the filter influent box decreases to a low level setpoint.
 - b. Floatable solids/scum removal
 - 1) At a set interval, the water level in filter (DF5100, DF5200) shall be allowed to rise above the scum weir elevation for a set duration to remove floatable solids and/or scum. Following the set duration, backwash should be initiated to lower water elevation back to a normal level.

3.5 SLUDGE PROCESSING (PID I-701,702)

A. Primary treatment modifications include:

1. One (1) Live Bottom Bin No.2 (LBB706) (Additive Alternate)

B. This device will be utilized to Convey sludge from other facilities into the existing live bottom bin.

- C. The system and associated conveyors will be operated by field control panel FCP7060.
 - 1. The system will be started and stopped via a signal from the level indicator LIT 7060 and the weight indicator WIT 7060.

3.6 ODOR TREATMENT (PID 1-801)

- A. Treatment Modifications include:
 - 1. One (1) Biological Odor Control System (BFT 8020)
 - 2. One (1) Chemical Media Odor Treatment System (Additive Alternate)
 - 3. One (1) Foul Air Fan (FAF8010)
 - 4. One (1) Recirculation Pump (P8030)
 - 5. One (1) Nutrient Feed Pump (P8040)
- B. This system is utilized to treat foul air from the Headworks Area
 - 1. The system is controlled by the vendor-supplied control panel.

3.7 POLYMER FEED SYSTEM (PID I-802)

- A. POLYMER FEED SYSTEM
 - 1. Specification Section: 46 33 33
 - 2. The purpose of the polymer feed system is to provide polymer to the existing Belt Filter Presses (BFP 7040 and BFP 7050) by diluting neat polymer. The system consists of two manufacturer dilution panels, mixing chambers, and polymer feed pumps.
 - 3. The pumps are designed to supply one belt filter press at a time. The systems will be valved to allow each system to provide either press with polymer.
 - 4. Dosage will be provided by FE 7040 and FE 7050

END OF SECTION 40 70 23

SECTION 40 71 13 – MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Magnetic flow meters.
2. Transmitters.
3. Indicators.
4. Recorders.
5. Integrators.

B. Related Requirements:

1. Division 26 - Electrical
2. Division 27 – Communications
3. Division 40 – Process Interconnections

1.2 REFERENCE STANDARDS

A. American Water Works Association:

1. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.
2. AWWA M33 - Flowmeters in Water Supply.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

C. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Coordinate Work of this Section with piping work.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports.
- C. Product Data:
 - 1. Dimensional drawings.
 - 2. Materials of construction.
 - a. Sensor
 - b. Liner
 - c. Electrodes
 - d. Process Connection
 - 3. Measurement accuracy.
 - 4. Range and range ability.
 - 5. Enclosure Rating.
 - 6. Classification Rating.
 - 7. Power.
 - a. Voltage
 - b. Wattage
 - 8. Output options.

1.5 QUALITY ASSURANCE

- A. Manufacture instruments in facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.
- B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

1.7 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.8 MAINTENANCE

- A. Provide all parts, materials, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.9 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

1.10 WARRANTY

- A. Section 017000 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for magnetic flow meters and appurtenant devices.

PART 2 - PRODUCTS

2.1 SYSTEMS/ASSEMBLIES

- A. Manufacturer:
 - 1. Rosemount 8750WA
 - 2. Or Approved Equal

2.2 MANUFACTURED UNITS

- A. The flow meter shall be a flanged sensor (by application and instrument schedule) and transmitter mounted integral (compact) to the sensor. Remote mounted transmitters shall be provided where shown on the drawings.
 - 1. The flow meter shall be microprocessor based and possess a method in which to store the sensor calibration and transmitter setup information in non-volatile memory. The electronics shall be interchangeable for meters sizes 1/2" – 18".
 - 2. The sensor shall be the proper size to measure the design flow rate of the piping and measure bi-directional flow without requiring any re-zeroing.
 - 3. The sensor shall be capable of installation with a minimum one diameter straight pipe from the sensor upstream flange and still meet specification performance.
 - 4. The sensor shall consist of a stainless-steel flow tube with stainless-steel flanges. The flanges shall carry Class 150 or Class 300 pressure ratings as specified.
 - 5. The system shall simultaneously produce multiple process variables (ex. volume flow and conductivity) while in operation.
 - 6. The sensor liner and electrode material shall be chosen to be compatible with the process fluid. All fluids require a minimum conductivity of 3µS/cm.
 - 7. The sensor tube shall be lined with PFA liner.
 - 8. The sensor shall house two bullet-nose measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be made of 316L SS, or Hastelloy C, electrolytic polished with non-stick self-cleaning finish and installed with live spring-loaded sealing system.

9. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
 10. Meter shall be capable of switching between 4 different ranges and forward/reverse 2-range switching.
 11. Meter shall have a full function dot-matrix 128 x 128 analog/digital LCD display backlit for night viewing that is electrically 360 degrees rotatable in 90 degree increments using the meter's software.
 12. All electronic circuit boards shall use resin on critical parts to provide resistance to vibration.
 13. Meter must be capable of normal operation during abnormal voltage conditions from a minimum of 80 volts during low voltage conditions or a maximum of 264 volts during over voltage conditions.
 14. The sensor shall be rated for IP67 and NEMA 4X as standard.
 15. The system shall be a compact design insensitive to external vibrations and immune from external piping forces due to robust design.
 16. Meter shall incorporate separate advanced noise suppression and multi-sampling signal filtering circuit, allowing all meters the ability to measure and be designed for: clean water, wastewater, and slurry applications. Auto zeroing, averaging, or dampening type algorithms in lieu of noise filtering circuitry are not acceptable.
 17. Built-in rate limit function shall be available to further eliminate extraneous output dynamics.
 18. Meter shall have user selectable excitation frequencies of 6Hz, 12Hz, or 24Hz to further reduce noise.
 19. Meter shall have: High, low, empty pipe, rate-of-change, limit alarms, control limit time, self-diagnostics and data checking, over-range flow, under-range flow, over totalize, under totalize, range change, preset output, adjustable low flow cutoff, totalizer preset value reached, reverse flow, and converter failure alarms as standard.
 20. Detector must have a 40-years or higher MTBF rated detector as printed in the vendor's specifications.
 21. The meter shall be lab calibrated twice by the manufacturer at 0%, 50%, and 100% of flow for a total of 6 calibrations.
 22. The meter shall have a standard certified flow accuracy of 0.2% of rate or better.
- B. The transmitter/converter shall have its own 'Built-in' field verification tool - which measures the coils excitation Current, optimized and established during the NIST calibration procedure for/of the detector/meter. The field verification tool measures in real-time/insitu, the NIST parameter, showing the meter is within the calibration parameter from its original NIST traceable flow lab calibration procedure. This measurement is accomplished through the converter without the need of other/external devices.
1. Converter shall have non-invasive 3 button infrared display that configures using a self-prompting menu without exposing the converter internals to the surrounding atmosphere.
 2. Converter shall be microprocessor based, have "built-in" diagnostics, and retain program configuration in memory for at least 10 years.
 3. The transmitter primary output shall be specified, as:
 - a. 4-20mA HART, or
 - b. Modbus RTU +4 20mA, or
 - c. Profibus PA, or
 - d. and capable of two digital outputs for alarms, batching, and pulse applications.

4. The transmitter output(s) shall be integral to the electromagnetic flowmeter transmitter electronics; using an external third party signal converter is unacceptable.
 5. Inputs shall be one digital input (20 - 30 Volts dc) for range switching, totalizer control, fixed value outputs, zero adjustment.
 6. All converters must have a 25 year or higher MTBF rated converter.
 7. Converter unit shall have an ambient temperature rating of at least -40°C to 60°C for remote flow tube with PFA liner, and -20°C to 60°C for remote flow tube with polyurethane rubber or hard rubber liner and remote/combined converter.
- C. Remote configuration shall be capable of being performed thorough the programmable automation controller with common off the shelf tools, software, interfaces or gateways. Generic profiles or special tools and hardware will not be acceptable.

2.3 ACCESSORIES

- A. Stainless steel tag – labeled to match the contract documents
- B. Provide grounding rings, as per manufacturer’s recommendations, if required.
- C. Provide sun shield for outdoor installations as required per the instrument schedule.

2.4 REQUIRED INSTRUMENTS

Tag	Size (inches)	Service	Meter Range	Anticipated Flow
FE/FIT-2034	16"	RW	500 – 3500 gpm	2,500 gpm
FE/FIT-3010	16"	RAS	700 – 4700 gpm	2500 gpm
FE/FIT-3020	16"	RAS	700 – 4700 gpm	2500 gpm
FE/FIT-3030	16"	RAS	700 – 4700 gpm	2500 gpm

2.5 SOURCE QUALITY CONTROL AND CALIBRATION

- A. Electromagnetic flow meters shall be factory calibrated on an ISO 17025 accredited test stand with certified accuracy traceable to NIST per “General Requirements for the Competence of Testing and Calibration Laboratories.”
- B. Evidence of accreditation must originate from a national verification agency such as A2LA.
- C. Each meter shall ship with a certificate of a 2-point calibration report exceeding stated standard accuracy of 0.5% or 0.2% of rate as specified.

- D. A real-time computer generated printout of the actual calibration data points shall indicate apparent and actual flows. The flow calibration data shall be confirmed by the manufacturer and shipped with the meters to the project site.
- E. The manufacturer shall provide complete documentation covering the traceability of all calibration instruments.
- F. The manufacturer shall provide ISA data sheet ISA-TR20.00.01 as latest revision of form 20F2321. The manufacturer shall complete the form with all known data and model codes and dash out the inapplicable fields. Incomplete data sheets submitted will result in a rejected submittal.

2.6 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. All devices shall be certified for use in hazardous areas, independent of the output protocol selected.
- C. At a minimum, the device shall allow installation in a Class I, Division 2, Group A to D as a non-incendive design.
- D. All devices shall be suitable for use as non-incendive devices when used with appropriate non-incendive associated equipment.
- E. Electrical equipment housing shall conform to NEMA 4X classification.
- F. Non-intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as cCSAus, FM, or UL for the specified electrical area classification.
- G. Device failure modes, self-monitoring characteristics and remedy diagnosis shall follow NAMUR standards NE 43 and NE 107.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process conditions.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical Drawings.

- B. As recommended by the manufacturer's installation and operation manual.
- C. Specific attention should be given to the following technical requirements:
 - 1. Verify ground rings (if required) have been installed according to the manufacturer's recommendations.
 - 2. Reduced inlet installations must be accompanied by manufacturer's documented evidence of third party testing and data collection in comparison to a traceable standard.

3.3 FIELD QUALITY CONTROL

- A. Each instrument shall be tested before commissioning and the ENGINEER shall witness the interface capability in the PLC control system and associated registers.
 - 1. Each instrument shall provide direct programming capability through the PLC.
 - 2. Each instrument shall provide direct control of totalizer reset functions through the PLC
 - 3. Each instrument shall be supported with a device profile permitting direct integration in the PLC.
- B. The ENGINEER shall witness all instrument verifications in the field.
- C. Manufacturers Field Services are available for start-up and commissioning by a Factory field service representative or a manufacturer's authorized service provider (ASP) – the warranty against manufacturing defects is three years.
 - 1. Manufacturer representative shall verify installation of all installed flow tubes and transmitters.
 - 2. Manufacturer representative shall notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.
 - 3. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability and electronics health. A comparative report shall be generated for each meter tested.
 - 4. Manufacturer representative shall generate a configuration report for each meter.

3.4 ADJUSTING

- A. Verify factory setup of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

- 1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 71 13

SECTION 40 72 24 – RADAR LEVEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Radar level transducer and transmitter where the measurement is not affected by changing media, temperature changes, gas blankets or vapors. Setup, Programming and commissioning of this device is possible via 4-20mA/Hart or a remote display or wireless via app using Bluetooth.

1.2 SUBMITTALS

- A. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports.
- B. Product Data:
 - 1. Dimensional drawings.
 - 2. Materials of construction.
 - a. Transmitter housing
 - b. Antenna or Horn
 - 3. Measurement accuracy.
 - 4. Range and range ability.
 - 5. Enclosure Rating.
 - 6. Classification Rating.
 - 7. Power.
 - a. Voltage
 - b. Wattage
 - 8. Output options.

1.3 QUALITY ASSURANCE

- A. A.Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.

- B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 CALIBRATION AND WARRANTY

- A. The meter shall have standard one-year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.
- B. Equipment to be supplied with Bluetooth wireless technology which can be used for configuration, set-up and diagnosis of the transmitter using a smart Bluetooth enabled phone or smart pad.

1.7 MAINTENANCE

- A. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 SYSTEMS/ASSEMBLIES

- A. Manufacturer:
 - 1. Endress+Hauser- Micropilot FMR10 / FMR20
 - 2. Rosemount – Model 5402AH1E54
 - 3. Or Approved Equal.

2.2 MANUFACTURED UNITS

- A. The pulsed time of flight radar transmitter shall operate at 26 GHz using 2-wire technology for level measurement and/or open channel flow measurement.

- B. Accuracy shall be $\pm 0.2''$ (FMR10) and $\pm 0.08''$ (FMR20) by application.
- C. Maximum measurement distance shall be 0-16ft (FMR10) and 0- 66 ft (FMR20) by application.
- D. The radar shall have CSA C/US General purpose approvals as required.
- E. Process Temperature range is -40 to 176 degrees F and pressure range is from -14.5 to 43 psi.
- F. The unit provides diagnosis information according to NAMUR NE107 with clear text messages to remedy.
- G. It must be possible to view a graphical representation of the actual signal and envelope curve on the display.
- H. The process connection shall be 1"NPT, 1.5"NPT, 2"NTP or 3"-6" ANSI flange connection by application. FMR10 series radar has 1"-1.5"NPT only and the FMR20 series radar has 1",1.5" and 2"NPT and 3"-6" flange options available.
- I. The radar output signal shall be 4-20 mA dc loop powered.
- J. The radar signal on alarm shall be scalable.
- K. The radar shall have a linearization function with up to 32 value pairs entered allowing conversion of the measured value into any unit of length, weight, flow or volume.
- L. The radar unit shall be rated for IP66 or NEMA 4x (FMR10) and IP66/68, NEMA4X/6P (FMR20) by application.
- M. The radar sensor body material shall be made of PVDF.
- N. The radar sensor must have hermetically sealed wiring and fully potted electronics eliminating water ingress.

2.3 ACCESSORIES

- A. Weather protection cover in PVDF
- B. Ceiling mounting bracket in 316L
- C. Flooding Protection Tube
- D. Remote RIA 15 digital display EX or Non EX rated
- E. Adjustable Mounting Bracket in 316L
- F. Service-specific accessories
 - 1. Field Care/Device Care

2.4 SOURCE QUALITY CONTROL AND CALIBRATION

- A. Provide ISA data sheet ISA-TR20.00.01. Use the latest revision of form 20F2321. Complete the form with all known data, and dash out the inapplicable fields. Incomplete data sheets submitted will be result in a rejected submittal.

2.5 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. All devices shall be capable of being certified for use in hazardous areas: Class I, II, III, Div. 2, Groups A-G.
- C. All devices shall be suitable for use as non-incentive devices when used with appropriate non-incentive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with vendor's approval.
- D. Transmitter housing shall conform to NEMA 4x classification.
- E. Non- intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, ETL, CSA, etc. for the specified electrical area classification.
- F. Electrical equipment specified as intrinsically safe shall qualify as "simple apparatus" or NRTL approved intrinsically safe equipment per ANSI/ISA-RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations", latest edition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process conditions.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical drawings.
- B. As recommended by the manufacturer's installation and operation manual.
- C. Specific attention should be given to the following technical requirements:
 - 1. Verify the nozzle height, dimension, and location where the transmitter has been installed.

3.3 FIELD QUALITY CONTROL

- A. Demonstrate the performance of all instruments to the ENGINEER before commissioning.
- B. ENGINEER to witness all instrument calibration verification in the field.
- C. Each instrument shall be tested before commissioning and the ENGINEER shall witness the response in the PLC control system and associated displays.
- D. Manufacturer's Field Services:
 - 1. Manufacturer's representative shall verify installation of all installed transmitters.
 - 2. Notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.

3.4 ADJUSTING

- A. Verify set-up and configuration of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

- 1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 72 24

SECTION 40 72 76 – LEVEL SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. A point level switch for use in hazardous areas with all international certificates. It is useable in all industries and has functional SIL2/SIL3 safety. It offers reliable measurement value that is not affected by flow, turbulence, bubbles, foam, vibration, bulk solids content or build-up.

1.2 SUBMITTALS

- A. Furnish complete Product Manufacturer's Technical Information, Operating and Maintenance
- B. Product Data:
 - 1. Dimensional drawings.
 - 2. Materials of construction.
 - 3. Measurement accuracy.
 - 4. Range and range ability.
 - 5. Enclosure Rating.
 - 6. Classification Rating.
 - 7. Power.
 - 8. Output options.

1.3 QUALITY ASSURANCE

- A. Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the Manufacturer.
- B. Any instruments that are not stored in strict conformance with the Manufacturer's recommendation shall be replaced.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 WARRANTY

- A. The meter shall have standard one-year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

1.7 MAINTENANCE

- A. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 LEVEL SWITCHES

A. MANUFACTURER:

- 1. Anchor Scientific
- 2. Or approved Equal.

B. MERCURY-FLOAT TYPE:

- 1. Switch Description: Two normally open (NO) mercury switches.
- 2. Relays: Intrinsically safe.
- 3. Float Casing: Polypropylene.
- 4. Housing: NEMA 250 Type 4X.
- 5. Cable: Oil-resistant thermoplastic.
- 6. Rated Voltage: 600 V.

C. REQUIRED INSTRUMENTS:

2.2 SOURCE QUALITY CONTROL AND CALIBRATION

- A. A Certificate of Compliance shall be available from the manufacturer if required.
- B. An application data sheet should be filled out, with all known data, and submitted to the manufacturer to ensure proper instrument choice

2.3 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. All devices shall be certified for use in the following hazardous areas:
 - 1. Explosion proof: Class I, Div. 1, Groups ABCD, Temperature rating T6 (Ta= 70°C)
 - 2. Intrinsically safe: Class I, II, III, Div. 1, Groups ABCDEF, Temperature rating T5 (Ta=70°C)
 - 3. Non- Incendive- Class I, Div. 2, Groups ABCD, Temperature rating T5 (Ta= 70°C)
- C. All devices shall be suitable for use as non-incentive devices when used with appropriate non-incentive associated equipment. Devices with intrinsically safe ratings will normally be acceptable with vendor's approval.
- D. Electrical housing shall conform to NEMA 4x classification.
- E. Non- intrinsically safe electrical equipment shall be approved by a Nationally Recognized Testing Laboratory (NRTL) such as FM, UL, ETL, CSA, etc. for the specified electrical area classification.
- F. Electrical equipment specified as intrinsically safe shall qualify as "simple apparatus" or NRTL approved intrinsically safe equipment per ANSI/ISA-RP12.6 "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations," latest edition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process conditions.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical drawings.
- B. As recommended by the manufacturer's installation and operation manual.

3.3 FIELD QUALITY CONTROL

- A. Demonstrate the performance of all instruments to the ENGINEER before commissioning.
- B. ENGINEER to witness all instrument calibration verification in the field.

- C. Each instrument shall be tested before commissioning and the ENGINEER shall witness the response in the PLC control system and associated displays.
- D. Manufacturer's Field Services:
 - 1. Manufacturer's representative shall verify installation of all installed transmitters.
 - 2. Notify the ENGINEER in writing of any problems or discrepancies and proposed solutions.

3.4 ADJUSTING

- A. Verify set-up and configuration of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

- 1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 72 76

SECTION 40 72 78 – OPTICAL ROTARY SHAFT ENCODERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rotary Hollow Shaft Optical Encoder for gate position measurement.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Control power wiring requirements.
2. Section 40 05 59 - Aluminum Slide Gates for Gates requiring position measurement.
3. Section 43 05 40 - Common Work Results for Gas and Liquid Storage: Process switching requirements as specified in this Section.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA ICS 16 Industrial Control and Systems: Motion/Position Control Motors and feedback Devices
2. NEMA ICS 1 - Industrial Control and Systems: General Requirements.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Section 40 05 59 - Aluminum Slide Gates.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Dimensional drawings.
2. Materials of construction.
 - a. Sensor

b. Process Connection

3. Measurement accuracy.
4. Range and rangeability.
5. Enclosure Rating.
6. Classification Rating.
7. Output options.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit installation requirements and other details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

A. Ensure that materials of construction of wetted parts are compatible with ambient corrosive environment.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for Rotary Encoders.

PART 2 - PRODUCTS

A. Rotary Hollow Shaft Optical Encoder

- 1. Manufacturers:
 - a. Allen-Bradley (Emerson)- St. Louis, MO.
 - b. Dynapar – Gurnee, IL
 - c. Approved Equal
- 2. Description: Minimum 100 PPR Hollow Shaft.
- 3. Material: Stainless steel.
- 4. Actuation: 12 Bit for Multi turn 12-22 Bit for Single Turn over the BISS Interface.
- 5. Accuracy: Plus or minus 1/32 inch of Optical Reading.
- 6. Output:
 - a. 4-20mA according to NEMA ICS 1.
 - b. Scalable either direction.
- 7. Enclosures: NEMA 250 Type 4X.
- 8. Mounting: Surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Coordinate location and orientation of Encoder assemblies with final equipment installations.
- B. Ensure that instruments are located to be easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one, 8 hour day on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 72 78

SECTION 40 73 13 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Pressure gages.
- B. Related Requirements:
 - 1. Section 40 73 64 – Annular Pressure Seals: Isolation of gages from process fluid.

1.2 REFERENCE STANDARDS

- A. ASME International:
 - 1. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- B. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
 - 1. Gages: Furnish 20 percent spare gages, with a minimum of one gage for each range used.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for pressure gages.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Ametek; Model Series 1550
 - 2. Ashcroft; Model Series 1010
 - 3. Wika; Model Series 716

- B. Type: Differential - Compound.
- C. Dials:
 - 1. Nominal Diameter: 4 inches.
 - 2. Face: White, laminated plastic dials with black graduations.
 - 3. Scale: Extend over arc not less than 270 degrees.
 - 4. Ranges and Graduation Units: As indicated on Drawings.
- D. Cases:
 - 1. Liquid filled.
 - 2. Stainless Steel case and wetted parts.
 - 3. Windows:
 - a. Material: Clear, shatterproof glass.
 - b. Thickness: 1/8 inch.
 - c. Provide gasket.
- E. Connection:
 - 1. Location: Bottom.
 - 2. Socket:
 - a. 1/4-inch NPT male thread.
 - b. Extend minimum 1-1/4 inches below gage cases.
 - c. Provide wrench flats.
 - 3. Mounting: Stem.
- F. Measuring Element:
 - 1. Bourdon Tubes:
 - a. Material: Stainless steel to brass socket.
 - b. Provide welded, stress-relieved joints.
 - 2. Movement:
 - a. Rotary.
 - b. Material: Stainless steel.
 - 3. Accuracy:
 - a. Comply with ASME B40.100.
 - b. Plus and minus 0.5 percent of full-scale range.
- G. Adjustment:
 - 1. Provide for zero-reading adjustment.

2. Adjusting Screws: Accessible from rear of case without need for disassembly.

H. Accessories:

1. Shutoff Cocks: Furnished by gage manufacturer.

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Coordinate location and orientation of gages and seal assemblies with final piping and equipment installations.
- C. Ensure that gages are located to be easily read during operation and easily accessible for maintenance.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 13

SECTION 40 73 26 – GAUGE-PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gauge-Pressure transmitters.

B. Related Sections:

1. Control and Information Systems Scope and General Requirements.
2. Power Instruments, General.

1.2 SUBMITTALS

A. Furnish complete product data, shop drawings, test reports, operating manuals, record drawings, Manufacturer's certifications, Manufacturer's Field Reports.

B. Product Data:

1. Dimensional drawings.
2. Materials of construction.
3. Measurement accuracy.
4. Measurement range.
5. Enclosure Rating.
6. Classification Rating.
7. Power.
8. Output options.

1.3 QUALITY ASSURANCE

A. Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.

1.5 PROJECT OR SITE CONDITIONS

- A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.6 WARRANTY

- A. The transmitter shall have a standard one-year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

1.7 MAINTENANCE

- A. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.8 LIFECYCLE MANAGEMENT

- A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 - PRODUCTS

2.1 SYSTEMS/ASSEMBLIES

- A. Manufacturer:
 - 1. Endress+Hauser - Cerabar S PMC71.
 - 2. Rosemount 2088 Pressure Transmitter

2.2 MANUFACTURED UNITS

- A. The transmitter shall be a 2-wire, high-performance capacitive pressure transmitter with digital communications capabilities including HART, Profibus PA or Foundation Fieldbus as required by the plans.
- B. Measure capacitance changes in the sensor as pressure varies and produces a linear 4-20mA DC output proportional to the pressure. The unit shall have self-diagnostic capability and a non-volatile memory; Histo-ROM memory module for monitoring of events, configuration changes and periodic recording of temperature/pressure values.

- C. Display shall be an integrally mounted 4-line LCD scaled with engineering units.
- D. Transmitter shall have a static pressure limit at least 1.5 times the nominal pressure range. Unit shall use DC loop-power supply 10.5 to 45 VDC with self-diagnostic capability and a non-volatile memory.
- E. Sensor shall be a high purity aluminum oxide ceramic element with no oil fill and an elastomer seal.
- F. The unit shall be rated for process temperature of minus 13°F to 302°F and an ambient environment of minus 40 degrees F to 185° F.
- G. Reference accuracy shall be +/- .075% of calibrated span including non-linearity hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including non-linearity hysteresis and non-reproducibility in addition to thermal change of the zero point shall be +/- .2% URL.
- H. The transmitter shall be programmable via Hall magnetic switch external pushbuttons without pressure source or hand held device.
- I. Unit shall have ATEX, FM, CSA or IECEx approvals as required.

2.3 ACCESSORIES

- A. Mounting set for installation of the transmitter on a wall or pipe (2").

2.4 REQUIRED INSTRUMENTS

2.5 SOURCE QUALITY CONTROL AND CALIBRATION

- A. Factory calibration of each pressure sensor traceable to the National Institute of Standards and Technology (NIST).
- B. A real-time computer-generated printout of the actual verification data indicating apparent and actual pressures at 0 percent, 50 percent and 100 percent of the calibrated range shall be included with each device.
- C. Provide ISA data sheet ISA-TR20.00.01. Use the latest revision of form 20P2201. Complete the form with all known data, and dash out the inapplicable fields. Incomplete data sheets submitted will be result in a rejected submittal.

2.6 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.

- B. All devices shall be certified for use in hazardous areas: Class I, II, III Div. 1, 2, Groups A-G; temperature rating T6 (85° C).
- C. Electrical equipment housing shall conform to NEMA 4x/6p classification.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures, and temperatures and furnish instruments that are compatible with installed process condition.
- B. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.2 INSTALLATION

- A. As shown on installation details and mechanical Drawings.
- B. As recommended by the manufacturer's installation and operation manual.

3.3 FIELD QUALITY CONTROL

- A. Demonstrate the performance of all instruments to the ENGINEER before commissioning.
- B. ENGINEER to witness all instrument calibration verification in the field.
- C. Each instrument shall be tested before commissioning and the ENGINEER shall witness the response in the PLC control system and associated registers.

3.4 ADJUSTING

- A. Verify set-up and configurations of all instruments in accordance with the Manufacturer's instructions.

3.5 PROTECTION

- 1. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - a. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION 40 73 23/26

SECTION 40 73 63 - DIAPHRAGM SEALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Diaphragm seals.
- B. Related Requirements:
 - 1. Section 40 73 13 - Pressure and Differential Pressure Gauges
 - 2. Section 40 73 26 - Gauge-Pressure Transmitters

1.2 REFERENCE STANDARDS

- A. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with piping work and pump installation.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation requirements and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment and accessories.

1.6 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for diaphragm seals.

PART 2 - PRODUCTS

2.1 DIAPHRAGM SEALS

A. Manufacturers:

1. Ashcroft Inc
2. Or approved equal.

B. Description:

1. Mounting:
 - a. Directly to pressure gage socket.
2. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
3. Provide fill/bleed screw for filling of diaphragm seal.
4. Instrument Connection: NPT, 1/4 inch.
5. Process Connection: NPT, 1/2 inch.
6. Flushing Connection: NPT, 1/4 inch.
7. Working Pressure Rating: Pipeline working pressure + 50 psig.
8. Calibration: Provide cleanout ring to be removed for recalibration or cleaning, without loss of filling liquid or change in calibration.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Diaphragm Seals:

1. Factory-assemble, fill, and calibrate entire assembly, including gage and switch, prior to shipment.
2. Field filling is not acceptable.

C. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Mount only one pressure element per diaphragm seal.
- C. Only for plant water installations.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 63

SECTION 40 73 64 – ANNULAR PRESSURE SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pressure Seals, Annular Type

B. Related Requirements:

1. Section 40 73 13 - Pressure and Differential Pressure Gauges: Pressure gages requiring isolation from process fluid.

1.2 REFERENCE STANDARDS

A. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.

C. Shop Drawings:

1. Indicate system materials and component equipment.
2. Submit installation requirements and other details.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of equipment and accessories.

1.5 QUALITY ASSURANCE

- A. Ensure that materials of construction of wetted parts are compatible with process liquid.
- B. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for diaphragm seals.

PART 2 - PRODUCTS

2.1 DIAPHRAGM SEALS

- A. Manufacturers:
 - 1. Ashcroft Model 80 Wafer Seal
 - 2. Red Valve Series 48 Pressure Sensor
 - 3. Onyx Isolator Ring
 - 4. Approved Equal
- B. Description:
 - 1. Mounting: Wafer Style.
 - 2. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
 - 3. Instrument Connection: NPT, 1/4 inch.
 - 4. Working Pressure Rating: Pipeline working pressure + 50 psig.
 - 5. Fill fluid: 50/50 solution of ethylene glycol and water, unless otherwise noted

2.2 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Diaphragm Seals:
 - 1. Factory-assemble, fill, and calibrate entire assembly, including gage or switch, prior to shipment.
 - 2. Field filling is not acceptable.
- C. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Mount only one pressure element per diaphragm seal.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 73 64

SECTION 41 13 12 – SHAFTLESS SCREW CONVEYOR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. The Contractor shall furnish, install, and place in satisfactory operation shaftless screw conveyors complete with all supports, spare parts, accessories and appurtenances as specified herein, show on the Drawings, and as required for a complete and operable system
2. The equipment shall comply with the requirements of Section 01 60 00 , Product Requirements
3. All necessary safety equipment and guards to meet OSHA requirements shall be provided
4. The Contractor shall be responsible for coordinating the placement all supports necessary to tie the equipment together and shall have the undivided responsibility for the system's structural integrity

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications: Miscellaneous metalwork and fasteners as required by this Section.
2. Division 26 - Electrical: Wiring connections to equipment.
3. Section 41 13 13 Live Bottom Bin

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM)
2. National Electrical Manufacturers Association (NEMA)
3. American Gear Manufacturers Association (AGMA)
4. American Welding Society (AWS)
5. Conveyor Equipment Manufacturers Association (CEMA)

1.3 SUBMITTALS

A. Section 01 33 00 Submittal Procedures: Requirements for submittals

B. Product Data: Submit manufacturer information for system materials and component equipment

C. Shop Drawings:

1. Indicate system materials and component equipment, including detailed wiring and control diagrams.
2. Indicate complete information concerning fabrication, installation, anchoring, fasteners, and other details.
3. Show dimensions
4. Indicate component materials, connections, and supports.

D. Manufacturer's Certificate:

1. Certify that the shaftless screw conveyor meets or exceeds specified requirements.
2. Certify that installation is completed according to manufacturer instructions and that screens have been properly installed and tested and are ready for operation.

E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and installer
2. Submit manufacturer's approval of installer

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:

1. Furnish one (1) set of manufacturer's recommended spare parts for each conveyor.

C. Tools: Furnish special tools and other devices required for Owner to maintain shaftless screw conveyor components.

1.6 QUALITY ASSURANCE

- A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.
- B. Manufacturer shall have a minimum of ten (10) years' experience with shaftless screw conveyor manufacturing and installation.
- C. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.
- D. Manufacturer shall provide all, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. The screening system shall be appropriately crated and delivered to protect against damage during shipment.
- C. Inspection: Accept materials on Site in original packaging and inspect for damage.
- D. Store equipment and components according to manufacturer instructions.
- E. Protect equipment and components from water and wet weather.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for screens and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Jim Meyers & Sons, Inc.
- B. KWS Manufacturing Company, Ltd
- C. Keystone Conveyor

- D. Spirac
- E. Approved Equal
- F. Any additional cost incurred due to approved equal equipment will be the Contractor's responsibility.

2.2 MANUFACTURERS INFORMATION

- A. The manufacturing company shall have a minimum of 10 years of experience providing municipal wastewater equipment, and at least 5 installations similar to the equipment specified within.

2.3 GENERAL

- A. All parts furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, transportation, erection and continuous operation. All materials for the conveyors shall be new and shall be of the very best quality, entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these specifications.
- B. The screw conveyor equipment shall be factory pre-assembled, factory pre-wired, and factory tested to the greatest extent practical.

2.4 EQUIPMENT

A. SPIRAL FLIGHTING

- 1. Spiral shall be manufactured from chromium nickel alloy steel with a brinell hardness of 250, and maximum yield strength of 80,000 psi.
- 2. Spiral flighting shall be designed to convey material without a center shaft.
- 3. The spiral flights shall be designed with the stability to prevent distortion and jumping in the trough. The torsional rating of the spiral shall be such that, at 150% of the motor nameplate horsepower, the drive unit cannot produce more torque than the torsional rating of the flighting. Spiral flights shall be 1" thick x 3" wide. Sectional flighting, formed from plate, shall not be permitted. Dual ribbon spirals may be provided when recommended by the manufacturer.
- 4. Connect spiral flighting to drive shaft by welding spirals to minimum 3/4 inch circular torque plate reinforced with curved gusset plate for 180 degrees. Drive shaft shall have a mating flange for bolting to the spiral flighting.
- 5. A gland packing ring consisting of two Teflon fiber packing rings shall seal the drive shaft at its penetration through the end plate, along with a greased labyrinth sealing system.

6. Compression and/or elongation: Less than 0.08 inch per 1 foot at maximum loading
7. Edges: Smooth in the as-rolled condition
8. Spirals shall be manufactured in a two-stage process. Single stage forming of diameter and pitch is not acceptable. Manufacturer shall certify the two-stage forming process, and this certification shall be included in the submittal information. Such two stages shall first consist of tightly cold rolling at zero pitch on a mandrel which uses a device to control the plastic flow of the spiral during forming and maintain a uniform outside and inside diameter thickness with no neck-down. The second stage of spiral forming shall consist of pulling the closely wound spiral in tension to the specified pitch in a device permitting free spiral rotation.

B. TROUGHS

1. Trough shall conform to CEMA Standards and be manufactured from T-304 stainless steel.
2. Minimum trough thickness (inch): 3/16 in.
3. A neoprene or rubber gasket shall be provided at each trough flange and between trough top and covers
4. CEMA standard trough end plates shall be provided with a split gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.
5. UHMW-PE Liner: 1/2" thick, in four (4) foot sections, held in place without penetrations or fasteners through trough, and replaceable
6. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape.
7. Drain: 3 inches from driven-end trough flange, bottom mounted, and welded perpendicular to the trough
8. Each trough shall be equipped with filling and/or discharge spouts at the location shown on the drawings. If required, each filling and discharge spout shall be flanged suitable for interconnection to other devices.

C. Conveyor Trough Covers

1. Conveyor Trough Covers: Trough covers should be 1/8 inch thickness, hinged and clamped. Flanged foul air connections shall be included. Each cover shall be less than 48 inches in length and shall have two hinges along one edge.
2. Hinges are located on the top of the conveyor trough U-flange and connect to the down-turned lip of the covers. Provide release to permit covers to be easily removable. Hinges

shall incorporate an integral back support for the cover to support the cover in an open position at an over-center position.

3. The covers shall be gasketed on all four sides. Each cover shall have a 1-inch turned-down edge on the two long sides of the covers with a bubble gasket fixed to the edges of the covers. The gaps between the covers shall have gaskets. Cover at chutes or bolted cover will have turned-down edges on two sides only. Each cover shall have a lifting handle, 3/8 inch diameter rod, approximately (plus 1/8 inch) 6 inches wide by 2 inches deep. The handle rod shall be fully welded to the cover.

D. Supports

1. Provide supports suitable for mounting as shown on the drawings and as required by supplier's design. The supports shall be capable of supporting the equipment weight when fully loaded. The supports shall be fabricated from standard shapes and plates. Supports shall be match marked and shipped to the job site for installation in the field.
2. At a minimum, each conveyor shall be provided with supports at the inlet and discharge end, with intermediate supports at 10 feet-0 inches on center.
3. Provide base plates at each support leg for anchor bolting
4. Height of support legs as indicated on Drawings
5. The supports shall be designed to avoid interference with other equipment or equipment supports.
6. Supports shall be manufactured from carbon steel.
7. All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member. In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction allowable stresses by more than 1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

E. Drive System

1. Drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. Gearmotor housing shall be cast iron, furnishing complete protection under all conditions of service. Gears shall be manufactured and rated for continuous duty in accordance with AGMA Standards, of heat-treated alloy steel. Provide splash type gear lubrication. Gear reducer shall be Class II speed reducer as manufactured by Eurodrive.
2. The gear reducer and drive shall be designed to provide an applied torque adequate to start a full loaded conveyor.
3. Drive shall have a minimum AGMA service factor of 1.4 and shall operate on 460V/3 phase/60 Hz power.

4. The drive system shall be provided with an instantaneous trip current relay for torque overload protection. The relay shall be provided with a time delay (adjustable) to short the relay on start-up and initial motor amp draw.
5. In the event of a prolonged power failure or emergency system shutdown, the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled at 2 times the design load.
6. Gearboxes and motors shall be factory-assembled on the conveyor, factory-tested and shipped fully assembled with the conveyors.

F. Safety Devices

1. Each conveyor shall be furnished with a pull cord emergency stop switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated. This device shall be in NEMA 4 enclosure.
2. A zero-speed switch shall be provided. The switch shall be housed in a NEMA 4 enclosure, mounted on the side of the conveyor U-trough with a stainless-steel bracket. The switch shall be a Milltronics WM100 or equal.

G. Hardware

1. All fasteners shall be hot dip galvanized or stainless steel. Zinc plated fasteners shall not be used.
2. All stainless-steel bolts shall be assembled using an anti-seize compound.
3. All structural bolts shall be A-325, hot-dip galvanized.

H. Fabrication

1. All parts and components shall be factory-assembled in sections convenient for field handling and installation but requiring the minimum amount of work for field assembly. Field welds at the jobsite by the Contractor for installation may be necessary when any overall conveyor length presents shipping or handling constraints.
2. Gears and gear drives as part of an equipment assembly shall be shipped fully assembled for field installation.
3. All assembled parts and components ready for shipment shall be securely bundled, coiled, or crated and adequately protected from damage and corrosion during shipment and storage.

I. Surface Preparation

1. Fabricated carbon steel components shall be shop blasted & hot dipped galvanized.

2. Drive unit shall include manufacturer's standard wash down duty paint system.

2.5 DESIGN REQUIREMENTS

- A. Shaftless Screw Conveyor:
 1. Number of units: 2
 2. Designation: SWC1050, SWC1060, and SWC1070
 3. Operating schedule: Intermittent duty
 4. Maximum Design handling capacity: 130 cu ft/hr
 5. Maximum incline: 0 degrees
 6. Length of trough/screw: 40 feet
 7. Minimum screw diameter: 9 inches
 8. Material density: 60 lb/ cu ft
 9. Percent solids: 15 percent - 20 percent solids by dry weight
 10. Maximum screw rotation speed: 20 rpm
 11. Minimum drive horsepower: 5.0 hp
 12. Trough bottom drain size: 6 inch
 13. Spray wash water connection: 3/4 inch

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, orientation, and connections.

3.2 INSTALLATION

- A. The screw conveyor shall be installed per manufacturer's written recommendations.
- B. Provide and install Manufacturer's recommended lubricants, oils, and greases.
- C. Anti-seize shall be applied to all stainless-steel bolt threads before assembly at the factory and or field assembly.

3.3 MANUFACTURER SERVICE

- A. Manufacturer's Field Services: The CONTRACTOR shall provide the following services in addition to any other services specified herein, and required by these Specifications.

1. A factory trained manufacturer's representative shall be provided for a minimum of two (2) trips and a minimum of three (3) eight-hour days to provide installation supervision, start-up and field-testing services, and O&M training services. The installation services shall be coordinated between the CONTRACTOR and the MANUFACTURER. The start-up and field-testing services, and the O&M services shall be coordinated with the ENGINEER.
2. After installation supervision and field-testing services by the manufacturer, the CONTRACTOR shall submit to the ENGINEER, a certification letter on the manufacturer's letterhead and signed by the manufacturer certifying that the equipment was installed per the manufacturer's recommendations.
3. All cost for site visits shall be included in the CONTRACTOR's Bid.

3.4 DEMONSTRATION

- A. Training shall be performed for Owner.

3.5 FIELD PAINTING

- A. Touch up and markings due to installation

3.6 CLEANING

- A. Conveyor shall be free from dirt, grease, or scratches caused by installation.

END OF SECTION 41 13 12

SECTION 41 13 13 – LIVE BOTTOM SLUDGE BIN

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Live Bottom Sludge Bin.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Miscellaneous metalwork and fasteners as required by this Section.
 - 2. Section 41 13 12 – Shaftless Screw Conveyor: for screw conveyors furnished under this section of specifications.
 - 3. Division 26 - Electrical: Wiring connections to equipment.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for live bottom bin materials and component equipment, including performance characteristics.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment, including detailed wiring and control diagrams.
 - 2. Indicate complete information concerning fabrication, installation, anchoring, fasteners, and other details.
 - 3. Indicate component materials, connections, and supports.
- D. Manufacturer's Certificate:
 - 1. Certify that equipment meets or exceeds specified requirements.
 - 2. Certify that installation is completed according to manufacturer instructions and that live bottom bins have been properly installed and tested and are ready for operation.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one (1) set of manufacturer's recommended spare parts for each live bottom bin.
- C. Tools: Furnish special tools and other devices required for Owner to maintain system.

1.5 QUALITY ASSURANCE

- A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.
- B. Manufacturer shall have a minimum of ten (10) years' experience with live bottom material handling systems.
- C. All equipment (live bin, and conveyor) shall be provided by the same manufacturer in order to ensure fit, form, and equipment coordination.
- D. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.
- E. Manufacturer shall provide live bottom, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. The live bottom system shall be appropriately crated and delivered to protect against damage during shipment.
- C. Inspection: Accept materials on Site in original packaging and inspect for damage.
- D. Store live bottom components according to manufacturer instructions.

- E. Protect live bottom components from water and wet weather.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for screens and components

1.8 DESIGN CRITERIA

- A. Wet Cake bins shall be sized and selected to meet the following:
 - 1. Number of wet cake bins: 1
 - 2. Type of wet cake: Dewatered municipal wastewater sludge
 - 3. Approximate Percent Solids: 15-25 %
 - 4. Minimum usable volume per bin: 25yd³
 - 5. Maximum total height per bin: 14'-3"
 - 6. Maximum ID width per Bin: 12'
 - 7. Minimum length: 13'
- B. Live Bottom shall be sized and selected to meet the following:
 - 1. Number of Shafted Screws Per Bin: 4
 - 2. Screw Length: 17'
 - 3. Minimum Live Bottom Total Width: 5'-4"
 - 4. Minimum Screw Diameter: 16"
 - 5. Minimum Screw Shaft Diameter: 8"
 - 6. Discharge Rate:
 - a. Minimum: 675 ft³/hr.
 - b. Maximum: 1300 ft³/hr

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Jim Meyers & Sons, Inc.

- B. KWS Manufacturing Company, Ltd
- C. Custom Conveyor – Division of Schwing Bioset, Inc.
- D. Approved Equal
- E. All equipment (live bin, and conveyor) shall be provided by the same manufacturer in order to ensure fit, form, and equipment coordination.

2.2 GENERAL

- A. Wet cake Bin shall be self-supporting with structural steel support legs and framing complete with base plates drilled for mounting on concrete base. All necessary cross bracing and reinforcing members shall be fabricated within the support system. A 4-inch Class 150 flanged connection shall be provided at the bottom of the Bin to drain the Bin during maintenance activities. Support system to be designed and stamped by a Professionally Licensed Engineer.
- B. Unless otherwise specified, the materials used in the fabrication of the equipment under this section shall conform to the following:
 - 1. Bin: T-304 stainless steel
 - 2. Inlet/Outlet Chutes: T-304 stainless steel
 - 3. Shafted Live Bottom Screws: Abrasion resistant A235 cs.
 - 4. Live Bottom Pan/Trough: T-304 stainless steel
 - 5. Bolts, Nuts, and Washers: 18-8 Stainless Steel
 - 6. Supports, Structural: A36 Carbon Steel, HDG.
 - 7. Platforms: A36 Carbon Steel, HDG.
- C. Welds: All interior hopper welds shall be sealed watertight by continuous welds, unless otherwise specified. Edge Grinding: Sharp corners of all cut and sheared edges shall be made smooth by a power grinder.
- D. Bin: Wet cake Bin shall be constructed of welded plate of a thickness determined by the manufacturer. It shall be designed to limit maximum deflection of no more than 1/270. Minimum plate thickness shall be 1/4-inch. Interior surfaces of Bin shall be smooth to allow unobstructed flow. All stiffening of Bin shall be welded to the exterior surface.
- E. Top Cover: Each wet cake Bin shall be supplied with a steel grizzly grating cover to allow sludge to fall through but prevent personnel from falling in.
- F. General: Include all material and equipment necessary to provide a complete working system, except such material and equipment specifically excluded. Provide all fasteners, whether shop installed or not, for structural supports and mechanical equipment.

- G. Clearances: Furnish equipment of the approximate dimensions shown or specified, to fit the spaces shown with adequate clearances, and capable of being handled through openings provided in the structure for this purpose. Provide equipment of such design that piping and electrical connections, ductwork and auxiliary equipment can be assembled and installed without causing major revisions to the location or arrangement of any of the facilities.
- H. Fabricated Sections: Furnish all fabricated steel sections shop assembled into units as large as practicable and as shipping regulations will permit and match marked for field assembly. Provide mechanical equipment and components shop mounted on the steel sections as much as practicable for shipment, in order to keep field assembly to a minimum. Furnish required lifting lugs.
- I. Miscellaneous Components: Shop Assemble all screws, bearings, end plates, and trough liners.
- J. Identification: Clearly identify all loose items by equipment number and erection mark numbers to facilitate assembly.
- K. Provide continuous seal welds in conformance with AWS D1.1 at all welded joints. Skip welds will not be permitted. After welding, clean stainless-steel components using a solvent free of chlorides. Remove embedded iron from stainless steel welds by pickling with nitric or hydrofluoric acid. Grind welds smooth and to a uniform finish.

2.3 EQUIPMENT COMPONENTS

A. RECEIVING BIN:

- 1. Provide flanges for connecting bins to live bottom troughs.
- 2. Side slope angles of not less than 60 degrees from the horizontal.
- 3. Design stiffening members to limit deflection of Bin to 1/270 of span.
- 4. Design Bin to rest on the support structure as shown on the Drawings.
- 5. Provide continuous welds at all welded Bin joints. Stiffeners do not require continuous welds.
- 6. Provide connections for level elements as shown on the Drawings.
- 7. Bins shall have integral support structure and anchors suitable for mounting to concrete vault structure
- 8. Design integral Bin supports for dead loads and live loads assuming Bins completely full of biosolids of 65 lb/ft³ density. Live loads are as specified on Drawings.
- 9. Design the Bins to have the minimum vertical clearance as specified on the Drawings.
- 10. Provide anchor bolts for support structure.

B. Live Bottom Screw Conveyors:

- 1. Provide a live bottom consisting of four nonreversible shafted screw conveyors.
- 2. Screw flights to be minimum 16-inch diameter.
- 3. Single flights with standard pitch shall be provided. Flight outside diameter shall be CEMA standardized sizes. Flights shall be of the required diameter and thickness to convey the specified material at the specified rate.
- 4. Sectional flights shall have a constant cross section. Flights shall be butt welded into a continuous helix, continuous throughout its entire section.
- 5. Pipe shaft shall be schedule 80 pipe and shall deflect no more than 0.25".

6. Coupling shafts shall be used to join screw augers. Coupling shaft shall fit inside the screw shaft with minimal play. Coupling shaft shall have matching bolt holes with screw shaft. Bolt holes shall be jig-drilled. Bolts shall secure coupling shaft and screw shaft together with a lock nut. Bolts shall be sized to adequately carry all loads generated by the conveyor. Drive, coupling, and tail shafts shall be manufactured from 1045 alloy steel. Coupling shafts shall be heat treated through induction hardening.
7. Flights shall be manufactured from abrasion resistant alloy steel AR235. Pipe shafts shall be manufactured from A53 carbon steel.
8. Conveyor pitch design shall permit even distribution of biosolids across Bin during biosolids discharge.
9. Provide radial and thrust flange bearings for screw flight drive and end shafts.
10. Provide externally mounted flange bearings, double tapered, grease lubricated roller bearings having an AFBMA C-10 rating life of 100,000 hours.
11. Provide grease fittings at each bearing and brought to an accessible location. (Alemite brand or Approved Equal)
12. Provide packing glands on outboard Bin wall to prevent contamination of bearings.
13. Designs incorporating inboard bearings, intermediate supports, or bearings located inside the Bin are not acceptable.
14. Fabricate screws to CEMA 300 Standards.

C. Conveyor Drive Units:

1. Provide live bottom drive unit with gear motor
2. One drive will be provided for each live bottom screw.
3. Provide drive supports as part of the Bin structure.
4. Provide inverter duty motors. Live bottom screw conveyor motors shall have space heaters and temperature sensing and protection.
5. Ensure output speed of bottom screw conveyor secondary gear reducer is as required for specified discharge rate.
6. Provide 1,800 rpm, 460-volt, 60 Hz, 3 phase motors with a 1.15 service factor, with Class F insulation. Furnish motors inverter duty.
7. Provide all gear reducers with AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings. Design bearings for thrust loads from the fully loaded startup condition with an AFBMA B10 life of 30,000 hours. Provide standard air-cooled reducer units with no auxiliary cooling. Size the gear reducer with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.
8. Maximum continuous operating torque shall be determined by Bin manufacturer for worst combination of service conditions, feed or discharge rate, and biosolids consistency.

D. Retractable Cover

1. The cover shall match the receiving bin material and be adequately stiffened and supported to prevent the deflection of the roof from exceeding L/360.
2. A section of the cover shall be retractable to allow receiving of dewatered sludge from a truck. Covers shall be designed for a 100 psf live load.
3. The retracting cover mechanism shall utilize a minimum 2" diameter, triple lead, ACME threaded rod. The rod shall be supported at each end with roller bearings.
4. The cover shall ride on phenolic V-groove wheels, with a track manufactured from the same material as the receiving bin.

5. The gate will operate by means of an electric actuator, sized as required to operate the cover
6. Electric actuators shall be as manufactured by:
 - a. Rotork
 - b. Limitorque
 - c. No alternate manufacturers are allowed.

2.4 SURFACE PREPARATION

- A. Stainless steel shall be acid washed and welds passivated to remove heat discoloration. Passivation by bead blasting will be acceptable.
- B. Fabricated carbon steel components shall be shop blasted & hot dipped galvanized.
- C. Drive unit shall include manufacturer's standard wash down duty paint system.
- D. Exterior (non-galvanized carbon steel):
 1. The exterior surface shall be thoroughly shop cleaned of all foreign material as recommended by the manufacturer, with a minimum of SSPC SP6 blast.
 2. A suitable primer and coating per Section 09 96 00- High Performance Coatings shall be applied to 6-10 mils DFT.
 3. Facing surfaces of bolted joints shall also be shop primed
- E. Interior (non-galvanized carbon steel):
 1. The interior surface shall be prepared to SSPC SP 10 "Near White" blast. Blasted surfaces shall be painted within 24 hours to prevent rusting and surface discoloration. Tnemec series 446 is to be applied to a dry film thickness of 12-18 mils.

2.5 CONTROL SYSTEM

- A. Power supply to the equipment will be 480 volts, 60 Hz, 3 phase.
- B. Control Panel:
 1. Panels shall be NEMA 4X, stainless steel.
 2. Equipment control panel shall be factory assembled, wired, and shall contain all necessary control devices for the operation of the discharge gates, load cells and other devices specified herein. Control devices include VFDs, motor starter, overloads, control power transformer, control switches, pilot lights, relays, interlocks with upstream and downstream process equipment, and other devices as required for a complete and operating system.
 3. The panel shall include a Hirschmann Model Gecko 4TX Managed Ethernet Switch and Hirschmann Model OZD 485 G12 BAS 943893321 Fiber Interface to provide connectivity to the plant-wide SCADA System furnished by others
 4. Entire control panel assembly shall be UL listed and mounted for operator control. Control panel shall include a main circuit breaker disconnect with externally operable handle lockable in the OFF position.
 5. An electric heater with integral thermostat shall be provided in the panel to prevent moisture accumulation.

- C. Level Sensing Device Connection: The Bin shall be furnished with connections for a level metering system consisting of an ultrasonic level transmitter for measuring the level of wet cake in the Bin. An admittance probe, with level switch, shall be supported vertically from the top of the Bin such that it will normally not be in contact with any wet cake.
1. Ultrasonic Level Transmitter:
- Ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and interconnecting cable.
 - Sensor shall be encapsulated in a chemical and corrosion-resistant material such as CPVC, and shall be suitable for operation over a temperature range of -20°F to 150°F, with a relative humidity of 10 to 100 percent.
 - Ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probe is provided, it shall be mounted with or adjacent to the ultrasonic sensor.
 - The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 0.5-inch.
 - The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output.
 - Transmitter output shall be an isolated 4-20 mA DC signal linearly proportional to the measured level range. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be within 0.5 percent of the level range.
 - The transmitter shall contain four independently adjustable level alarm contact outputs. Contacts shall be single pole, double-throw, and rated not less than 5 amps at 120 volts AC.
 - An appropriate length of sensor-to-transmitter signal cable shall be furnished with the instrument. The sensor shall be capable of being located up to 100 feet away from the signal converter. The signal converter electronics shall be housed in a corrosion resistant NEMA 4X enclosure suitable for wall or pipe stand.

PART 3 - EXECUTION

3.1 INSTALLATION

- Live Bottom Bin shall be installed per manufacturer's written recommendations.
- Provide and install Manufacturer's recommended lubricants, oils, and greases.
- Anti-seize shall be applied to all stainless-steel bolt threads before assembly at the factory and or field assembly.

3.2 WARRANTY

- A. The supplier shall guarantee in writing that the equipment furnished is appropriate for the intended service and shall be free of manufacturing and fabrication defects in material and workmanship for a period of 1 year after the equipment is satisfactorily placed in service.

3.3 MANUFACTURER SERVICE

A. Manufacturer's Field Services:

1. A factory trained manufacturer's representative shall be provided for a minimum of three (3) trips and a minimum of four (4) eight-hour days to provide installation supervision, start-up and field testing services, and O&M training services. The installation services shall be coordinated between the CONTRACTOR and the manufacturer. The start-up and field-testing services, and the O&M services shall be coordinated with the ENGINEER.
2. After installation supervision and field-testing services by the manufacturer, the CONTRACTOR shall submit to the ENGINEER, a certification letter on the manufacturer's letterhead and signed by the manufacturer certifying that the equipment was installed per the manufacturer's recommendations.
3. The manufacturer shall provide operator training to all required plant personnel.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, on-line operations, routine maintenance, and emergency repair procedures to Owner's personnel.

3.5 FIELD PAINTING

- A. Touch up and markings due to installation

3.6 CLEANING

- A. Live Bin shall be free from dirt, grease, or scratches caused by installation.

END OF SECTION 41 13 13

SECTION 44 31 17 – CHEMICAL MEDIA ODOR TREATMENT EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Chemical Media Odor Treatment Equipment and Accessories.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
 - 2. Section 44 31 21 - Odor Control Biofilter.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment.
- C. Shop Drawings:
 - 1. Certified shop drawings showing all details of equipment and dimensions.
 - 2. Descriptive literature, bulletins and/or catalogs of equipment including the last five installations of similar equipment.
 - 3. The weight of each major item of equipment.
 - 4. Design loads to the foundation for review and approval prior to fabrication.
 - 5. A bill of materials for equipment.
 - 6. A list of the manufacturer's recommended spare parts. Include gaskets, seals, etc, on the list.
 - 7. Complete data on the head loss for the air flow through the vessel at the design air flow rate and at the maximum head loss prior to carbon change-out.
 - 8. Complete data on the activated carbon showing it to be in conformance with this Section. Include a complete analysis of the capacity of the activated carbon to adsorb hydrogen sulfide and expected life of the carbon (months) based on anticipated inlet conditions.
 - 9. Submit installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

I. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed biofilters.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.5 QUALITY ASSURANCE

- A. Inspection and Testing Requirements: The Owner reserves the right to refuse delivery of any or all pieces of equipment found, upon inspection, to have any defects in workmanship or materials.
- B. Upon completion of the installation each piece of equipment in each system shall be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on equipment manufacturer specifications and all applicable codes and standards. All equipment must be adjusted and checked for misalignment, clearances, supports and adherence to safety standards.

1.6 QUALIFICATIONS

- A. Manufacturer: The products furnished under this section shall be by manufacturer that has been regularly engaged in manufacturing of the equipment and has a minimum of 8 years' experience in design fabrication and testing of biological odor control systems.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Contractor shall warranty the entire system, both in material and workmanship for a period of eighteen months (18) months from the date of final acceptance.
- C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced and the complete system restored to service at no expense to the Owner.
- D. The chemical media, furnished with the equipment, shall be guaranteed for 4 years from the date of delivery.

PART 2 - PRODUCTS

2.1 CHEMICAL MEDIA ODOR TREATMENT EQUIPMENT

A. Manufacturers:

1. Purafil Filtration Group (Model DBS708) – Doraville, GA.
2. Approved Alternate - Specifications and equipment arrangements for the Chemical Media Odor Treatment Equipment are based on Purafil Filtration Systems equipment. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

B. PERFORMANCE AND DESIGN REQUIREMENTS

1. General design criteria:
 - a. The configuration shall be arranged so that the contaminated air shall flow through the inlet plenum and through the Mist Eliminator. Then the contaminated air shall flow horizontally through the media bed. Treated air shall discharge out of the end of the vessel through an exhaust with a rain louver.
 - b. Media type: Proprietary Dry Chemical Media
 - c. Orientation: Aboveground
 - d. Chemical media life: 4 years minimum
2. Odor treatment facilities:

- a. Air flow to collect and treat: 5,000 acfm
- b. Average hydrogen sulfide concentration: 1 ppm
- c. Maximum hydrogen sulfide concentration: 30 ppm
- d. Minimum hydrogen sulfide removal rate at design condition: 99.5 percent.
- e. Maximum vessel pressure drop: 7.5 inches W.C
- f. Foul air inlet relative humidity: 35 to 90 percent
- g. Foul air inlet temperature: 55 to 120 Fahrenheit
3. Chemical Media Odor Treatment System:
 - a. Designation: DBS8050
 - b. Maximum system footprint dimensions (length by width): 9 feet by 16 feet

2.2 SYSTEM COMPONENTS

A. Mist Eliminator:

1. Housing of aluminum construction shall be provided.
2. The mist eliminator shall be a polypropylene mesh filter consisting of 6 layers of 16/96 KIMRE mesh.
3. Pressure taps and gages shall be installed to permit a local read out of the pre-filter pressure drop.
4. An inlet transition shall be provided by the vessel manufacturer, from the outlet of the adjacent Biofilter furnished under Section 44 31 21 - Odor Control Biofilter.

B. Media Bed Section

1. The bed shall include 64 cu ft. 2,560 lbs.) of OdorCarb Ultra media and 128 cu ft. (5,120 lbs.) of OdorMix SP media.
 - a. Media 1 - Odorcarb Ultra media as manufactured by Purafil, Inc. with the following characteristics:

Minimum Removal Capacities

Contaminant Gas	g/cc	Weight %
Hydrogen Sulfide (H ₂ S)	0.3008	47.00

- 1) Density 40 lbs. per cubic ft (.64 g/cc) +/- 5%
- 2) Air Speed up to 100 fpm (0.51 m/s) in bulkfill applications
- 3) 99.5% (min) initial removal efficiency
- b. Media 2 - Odormix SP media as manufactured by Purafil, Inc. Odormix SP Media is made from an equal mix (by volume) of Purafil's Odoroxidant SP media and Odorkol media. Odormix SP has the following characteristics:

Minimum Removal Capacities

Contaminant Gas	g/cc	Weight %
Sulfur Dioxide (SO ₂)	0.0520	8.13
Nitrogen Dioxide (NO ₂)	0.1434	22.41
Toluene (C ₆ H ₅ CH ₃)	0.0792	12.38

- 1) Density 40 lbs per cubic ft (.64 g/cc) +/- 5%
- 2) Air Speed up to 100 fpm (0.51 m/s) in bulkfill applications
- 3) 99.5% (min) initial removal efficiency

- c. Media must be Non-Hazardous before and after it is spent.
- d. All media must have proof that is made and produced in the United States for additional verification of product performance.
- e. All media must be testable for capacity and life.

2.3 INSTRUMENTATION

- A. Differential Pressure: 2gauge(s) shall be included with the scrubber to permit local read-out of pressure drop through the Mist Eliminator and the Chemical Media Section.
- B. Gauge shall be Magnehelic type as manufactured by Dwyer (Series 2000) or approved equal.

2.4 CONTROL PANEL

- A. NEMA 4X, 316 stainless steel enclosure
- B. Control power transformer, 460/120 VAC, with fused primary and secondary.
- C. Main circuit breaker, magnetic, with front-panel operating handle.
- D. Operator interface and display:
 - 1. "Hand-Off-Auto" selector switch
 - 2. Indicating lamps (all lamps are push-to-test style):
 - 3. "Fan Off"
 - 4. "Fan Running"
- E. Accessories: Air inlet, air outlet, media support, drain and all connections shown on the Contract Drawings shall be provided by the manufacturer. Tie down lugs shall be provided. All external bolts shall be Type 316 stainless steel and designed for the specified loads. Interior fasteners shall be of corrosion resistant materials such as PVC, FRP or 316 SS.
- F. Neoprene Pad: A 1/4-inch thick, 60 durometer neoprene rubber sheet must be placed underneath the vessel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facility, piping, and electrical Work are ready to receive Odor Treatment Equipment and accessories.

3.2 INSTALLATION

- A. According to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Inspect for proper operation.

C. PERFORMANCE TESTING

1. Performance testing shall not commence until the Manufacturer and Owner agree that the system has been satisfactorily started-up and sufficient time has been allowed for the acclimation of the bacteria.
2. After the odor control system has been satisfactorily started-up and switched to normal operation, the Contractor shall, in the presence of the Owner, demonstrate that the system will perform as specified.
3. The Contractor, with the assistance of the manufacturer, shall provide the Engineer with a written test protocol and the performance testing may not be conducted until the test protocol has been reviewed and approved by the Engineer.
4. The Contractor shall supply, install and operate all equipment, sensors and instrumentation required to complete the performance testing.
5. H₂S Testing Procedure
 - a. Measure airflow into each unit and adjust to the design airflow +/-10% if necessary. Airflow shall be measured at the beginning of the test period. The set position on the damper shall be marked or noted. Airflow shall not change as long as damper remains in position.
 - b. Measure pressure drop across the system at beginning of test period.
 - c. Measure temperature and relative humidity of the inlet, outlet and ambient air.
 - d. Performance test period shall begin at a noted time and last for four (4) hours. H₂S data from the common inlet location and from the outlet of each odor control system shall be measured and logged once every 10 minutes to demonstrate performance during the test period.
 - 1) The inlet H₂S data shall be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the inlet air stream (0-200 ppmv range, 1 ppm display resolution or 0.0-50.0 ppmv range, 0.1 ppmv display resolution).
 - 2) The outlet H₂S data shall be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the outlet air stream (0.00-2.00 ppmv range, 0.01 ppmv display resolution).
6. H₂S Acceptance Criteria
 - a. The system's H₂S removal efficiency shall be determined by calculating the average inlet H₂S concentration and the average outlet H₂S concentration. Data points that are greater than 2x the average will not be included in the calculation.

The H₂S removal efficiency must meet the criteria specified above for the system to be accepted.

3.4 MANUFACTURER SERVICES:

- A. Installation Verification and Startup guidance: Manufacturer's factory trained engineer for One (2) trips, Two (2), Eight (8) hour day each trip.
- B. Training: Manufacturer's factory trained engineer for One (1) separate trip, Eight (8) hours and includes both classroom and hands on training.

3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control functions and adjust as required.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 44 31 17

SECTION 44 31 21 - ODOR CONTROL BIOFILTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Odor control Biofilters and Accessories.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.

1.2 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. HDPE: High-density polyethylene.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information for system materials and component equipment.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- I. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed biofilters.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.6 QUALITY ASSURANCE

- A. Inspection and Testing Requirements: The Owner reserves the right to refuse delivery of any or all pieces of equipment found, upon inspection, to have any defects in workmanship or materials.
- B. Upon completion of the installation each piece of equipment in each system shall be tested for satisfactory operation without excessive noise, vibration, overheating, etc. Compliance shall be based on equipment manufacturer specifications and all applicable codes and standards. All equipment must be adjusted and checked for misalignment, clearances, supports and adherence to safety standards.

1.7 QUALIFICATIONS

- A. Manufacturer: The products furnished under this section shall be by manufacturer that has been regularly engaged in manufacturing of the equipment and has a minimum of 8 years' experience in design fabrication and testing of biological odor control systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Contractor shall warranty the entire system, both in material and workmanship for a period of eighteen months (18) months from the date of final acceptance.
- C. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced and the complete system restored to service at no expense to the Owner.
- D. The biological media, on which the biological culture is grown, shall be guaranteed for 15 years from the date of delivery.

PART 2 - PRODUCTS

2.1 BIOFILTERS

A. Manufacturers:

1. BioAIR Solutions, LLC – Voorhees, NJ.
2. Biorem Environmental (US) Ltd. – Victor, NY.
3. EcoVerde Technologies – Tempe, AZ
4. Daniel Company – Upland, CA

B. PERFORMANCE AND DESIGN REQUIREMENTS

1. General design criteria:
 - a. Minimum design detention time: 15 seconds
 - b. Media type: Inorganic or synthetic
 - c. Orientation: Vertical, upflow cylindrical vessel
 - d. Inorganic media life: 15 years minimum
2. Odor treatment facilities:
 - a. Air flow to collect and treat: 5,000 acfm
 - b. Average hydrogen sulfide concentration: 250 ppm
 - c. Maximum hydrogen sulfide concentration: 900 ppm
 - d. Minimum hydrogen sulfide removal rate at design condition: 99 percent, or less than 1 ppm.
 - e. Minimum total odor removal rate: 90 percent
 - f. Maximum vessel pressure drop: 2 inches W.C
 - g. Foul air inlet relative humidity: 35 to 90 percent
 - h. Foul air inlet temperature: 55 to 120 Fahrenheit
3. Biofilter:

- a. Designation: BFT8020
 - b. Maximum system footprint dimensions (length by width): 16 feet by 24 feet
4. Recirculation pump:
 - a. Designation: P8030
 - b. Capacity: as required by Biofilter manufacturer.
 - c. Motor size: less than 5.0 hp
 - d. Minimum inlet water pressure: 40 psig
 - e. Make-up water hardness: Less than 50 ppm
5. Foul air fan:
 - a. Designation: FAF8010
 - b. Number of unit: 1
 - c. Capacity: 5,000 acfm
 - d. Discharge pressure: 12 inches W.C.
 - e. Motor size: 7.5 hp

2.2 SYSTEM COMPONENTS

A. Biotrickling Filter Vessel:

1. The reactor vessel shall be free standing, packaged or skid mounted. Vessel shall be constructed from fiberglass reinforced plastic (FRP) in accordance with ASTM D4097 and C582, treated to withstand UV light. Vessel shall be completely corrosion resistant.
2. All gaskets shall be EPDM.

B. Accessories: Air inlet, air outlet, spray headers, baffles, media support, drain and all connections shown on the Contract Drawings shall be provided by the manufacturer. Tie down lugs shall be integrally molded into the walls of the vessels. All external bolts shall be Type 316 stainless steel and designed for the specified loads. Interior fasteners shall be of corrosion resistant materials such as PVC, FRP or 316 SS.

C. Neoprene Pad: A 1/4-inch thick, 60 durometer neoprene rubber sheet must be placed underneath each vessel.

D. Biotrickling Filter Media

1. The synthetic structured media shall be high porosity, chemically resistant, engineered synthetic porous material.
2. The biological media characteristics (available surface area, density, and pressure drop) shall be structured and uniform throughout the media bed.
3. Media shall resist compaction or swelling due to varying moisture levels and shall not degrade when subjected to low pH (i.e. pH<2) conditions.
4. The uniform structure of the media shall minimize the potential for short circuiting and encourage a uniform water and air flow pattern over the entire media cross sectional area.

E. Irrigation System

1. Each reactor shall be configured with an irrigation system which shall evenly distribute the irrigation water over the entire upper surface of the synthetic media layer.
2. Each irrigation system shall be tested by the Manufacturer and a certificate of conformity supplied with the shop drawings to show that the nozzle has been tested and meets the Manufacturer's standards for uniform distribution.
3. The irrigation system shall be supplied with a nutrient addition system to provide the nutrients, if required, for the bacteria for optimal metabolism of the odorous compounds being treated.

F. Odor Control Blower

1. The blower shall be centrifugal PP or FRP with 316SS shaft and airstream components designed for corrosive environment. As manufactured by IPF, Texel-Seikow, Verantis or pre-approved equal. Fan shall be appropriately sized by the system Manufacturer to include losses through the entire system.
2. HOUSINGS: All housings shall be materials appropriate for exposure to sewage gases and low pH environment. All units shall be built with an adjustable discharge housing which can be field rotated to any of eight standard positions.
3. WHEELS: The wheel shall be of the radial bladed backplate or backward curved design, and shall be made of materials appropriate for exposure to sewage gases and low pH environment. Wheels shall be statically and dynamically balanced.
4. MOTORS: The blower motor shall be a TEFC electric motor for operation on 3/60/230-460V, as shown on the Electrical Drawings or as required, as manufactured by US Motors, Baldor, Reliance, Weg or pre-approved equal.
5. Motor bearings shall have a minimum L-10 life, as defined by AFBMA, of at least 40,000 hours (200,000 hours average life).
6. BALANCING: Prior to shipment all fans shall be completely assembled and test run as a unit at the operating speed. Final balance of the completed fan assembly shall be taken by electronic equipment. Records of the vibration readings in the axial, vertical, and horizontal planes shall be maintained and a written copy of this record shall be available upon request.
7. Blower noise shall be less than 75 dBA at 3 feet from the system or less than 50 dBA at 10 feet.

2.3 INSTRUMENTATION AND CONTROLS

A. Electrical Control Panel (FCP8010)

1. The FCP enclosure shall be NEMA 4X and constructed of 304 stainless steel.

2. The FCP shall house the necessary electronic components for the control and monitoring of the irrigation system. The system shall be controlled on the basis of time for the irrigation cycle and irrigation time shall be adjustable to sustain conditions appropriate to the activity of the bacteria. There shall be an allowance to manually operate the irrigation spray for the purpose of routine maintenance checks.
3. The FCP shall include a variable frequency drive (VFD) for the foul air fan with speed controls based on proving a constant differential pressure across the biofilter.
4. Interlocks shall be provided for use of downstream polishing processes, should the owner elect to include these in the project.
5. The FCP shall require a single electrical connection as shown on the Electrical Drawings or as required.
6. All electronic components shall be rated for Class 1, Division 2 environments.

B. Water Control Panel (WCP)

1. The Water Control Panel shall be constructed of 304 stainless steel.
- 2.
3. The WCP shall contain, valves, solenoid valves, strainers, metering pumps, pressure gauges, flowmeters, instruments and piping, as needed, for the control of the irrigation system and nutrient feed system and shall operate from control signals from the FCP.
- 4.
5. The WCP shall allow for a single connection to plant service water system and a single connection for a recirculation pump.
- 6.
7. The WCP shall house the nutrient addition system.

PART 3 - EXECUTION

3.1 FACTORY ACCEPTANCE TEST

A. FRP Vessels

1. FRP vessels shall be inspected prior to shipping for conformance to the following:
2. Dimensions match those shown on submittal drawings and are within Manufacturer's specified tolerances.
3. Flanges and connections between reactor parts fit securely without improper bending or stressing of parts.
4. Damage or imperfections, including cracking/crazing are minimal and in accordance with this specification.
5. Manufacturer shall keep a record of the quality control document for each reactor vessel that is available to the Engineer upon request.

B. Electrical Control Panel:

1. Electrical control panel shall be inspected prior to shipping for conformance to the following:
2. NEMA rating according to this specification
3. PLC program shall be tested for proper communication and functionality.
4. PLC digital and analog inputs shall be electrically tested to ensure input recognition in the proper area of the PLC program.
5. All wiring between panel components and terminal strips shall be checked for proper labeling and connection.

C. Water Panel

1. All water panel piping and/or other pre-installed piping shall be tested prior to shipping for conformance to the following:
2. System shall have no leaks when subjected to a pressure test at 80 psi for a minimum of 1 hour.
3. All installed instruments, sensors, pumps, actuated valves, and other electrical components shall be tested for proper operation.
4. All wiring from terminal strips to all electrical components shall be tested to ensure proper wiring.

D. Spray Nozzles

1. Irrigation system shall be factory tested to ensure compliance with Manufacturer standards for uniform distribution

3.2 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that facility, piping, and electrical Work are ready to receive biofilters and accessories.

3.3 INSTALLATION

- A. According to manufacturer instructions.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspect for proper operation.
- C. PERFORMANCE TESTING

1. Performance testing shall not commence until the Manufacturer and Owner agree that the system has been satisfactorily started-up and sufficient time has been allowed for the acclimation of the bacteria.
2. After the odor control system has been satisfactorily started-up and switched to normal operation, the Contractor shall, in the presence of the Owner, demonstrate that the system will perform as specified.
3. The Contractor, with the assistance of the manufacturer, shall provide the Engineer with a written test protocol and the performance testing may not be conducted until the test protocol has been reviewed and approved by the Engineer.
4. The Contractor shall supply, install and operate all equipment, sensors and instrumentation required to complete the performance testing.
5. H₂S Testing Procedure
 - a. Measure airflow into each unit and adjust to the design airflow +/-10% if necessary. Airflow shall be measured at the beginning of the test period. The set position on the damper shall be marked or noted. Airflow shall not change as long as damper remains in position.
 - b. Measure pressure drop across each biotrickling filter at beginning of test period.
 - c. Measure temperature and relative humidity of the inlet, outlet and ambient air.
 - d. Performance test period shall begin at a noted time and last for eight (8) hours. H₂S data from the common inlet location and from the outlet of each odor control system shall be measured and logged once every 10 minutes to demonstrate performance during the test period.
 - 1) The inlet H₂S data shall be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the inlet air stream (0-1000 ppmv or 0-200 ppmv range, 1 ppm display resolution or 0.0-50.0 ppmv range, 0.1 ppmv display resolution).
 - 2)
 - 3) The outlet H₂S data shall be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the outlet air stream (0.00-50 ppmv range, 0.01 ppmv display resolution or 0.0-50.0 ppmv range, 0.1 ppmv display resolution).
6. H₂S Acceptance Criteria
 - a. The system's H₂S removal efficiency shall be determined by calculating the average inlet H₂S concentration and the average outlet H₂S concentration and using the following formula: H₂S removal efficiency (%) = (1 – average inlet H₂S concentration/average outlet H₂S concentration) x 100. Data points that are greater than 2x the average will not be included in the calculation. The H₂S removal efficiency must meet the criteria specified above for the system to be accepted.

3.5 MANUFACTURER SERVICES:

- A. Installation Verification and Startup guidance: Manufacturer's factory trained engineer for two (2) trips, Two (2), Eight (8) hour day each trip.
- B. Training: Manufacturer's factory trained engineer for One (1) separate trip, Eight (8) hours and includes both classroom and hands on training.

3.6 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control functions and adjust as required.

3.7 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 44 31 21

SECTION 44 33 11 - ODOR CONTROL COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removable, clear-span, flat aluminum covers for odor control on process structures.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM B308—Aluminum Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded.
 - 2. ASTM C509— Cellular Elastomeric Preformed Gasket and Sealing Material.
- B. American Welding Society:
 - 1. AWS D1.2—Structural Welding Code--Aluminum
- C. Aluminum Association:
 - 1. AA30—Aluminum Association Specifications for Aluminum Structures.

1.3 ACTION SUBMITTALS

- A. Product Data: Provide manufacturers literature describing materials of construction, parts and accessories including general assembly, controls and wiring diagrams, pressure and temperature ratings and additional information necessary to determine compliance with these specifications
 - 1. Manufacturer, model and type
 - 2. Detailed specifications and data describing materials, parts and accessories used
 - 3. Manufacturer's standard guarantee and letter from manufacturer approving the subcontractor installing the cover
 - 4. Complete set of design calculations for the cover systems. Calculations stamped and signed by a registered Professional Engineer. If computerized design is performed, include the input and output data used. Manufacturer design calculations are not subject to review or approval by the Engineer and are only required for documentation purposes. The manufacturer is solely responsible for design of the covers
- B. Shop Drawings:

- a. Indicate layout, general assembly, components, dimensions, weights, clearances for maintenance, and methods of assembly and installation details, prepared to scale
- b. Sufficient data to verify compliance with the specifications and to illustrate construction and assembly of the products
- c. Complete and detailed assembly and installation drawings
- d. Setting drawings and templates for location and installation of anchorage devices
- e. Complete shop drawings for the fabrication and erection of all work. Include plans, elevations, and details of sections, connections, showing anchorage and gaskets.

1.4 PERFORMANCE AND DESIGN REQUIREMENTS

A. Environmental Conditions:

1. Equipment suitable for installation outdoors.
2. Covers will enclose headworks area of wastewater treatment plant.
3. Covers may be subject to splash of the process liquids.
4. Ventilation air circulating through the enclosed tank will maintain conditions of 100 percent humidity with concentrations of up to 250-900 ppm of hydrogen sulfide under the cover which may form sulfuric acid on the underside of the cover when the hydrogen sulfide comes into contact with water condensation.
5. Temperature within the enclosure varies with wastewater temperature within 11 and 30 degrees Centigrade.
6. Temperature on the exterior skin of the cover will vary with weather conditions seasonally from 32 degrees F in winter to 105 degrees F in summer.
7. Exterior surfaces continuously exposed to direct sunlight and rain.

B. Type:

1. All aluminum or stainless steel construction.
2. Self-supporting from the existing peripheral structure.
3. Panels manually removable by no more than two people without the use of mechanical lifting devices or cranes.
4. Form a system of overlapping joints with a substantially air-tight, water-tight surface over the entire process tank opening.
5. Joints independent and not fastened together.
6. Non-corrugated.
7. Nominally flat.

C. Design Requirements:

1. Designed by the manufacturer to fit within the structure as shown on the Drawings. These provisions, however, shall not be construed as relieving the contractor of overall responsibility for the work.
2. Design of the cover coordinated with the design of the equipment installed in the tank to ensure that the cover or any part of the cover support system does not interfere with the screening equipment, grit removal equipment and pumping equipment, overflow troughs, or any isolation gates.
3. Full provisions to allow for thermal expansion and contraction for a temperature differential of 100 degrees F under the loading conditions specified
4. Aluminum cover designed in accordance with AA30, ASCE 7-88 and UBC
5. Live load: 60 psf

6. Internal negative (vacuum) ventilation pressure: 0.2 inch water column
7. Wind load (uplift): 10 psf
8. Isolated load of 250 pounds, minimum, applied to one square foot at any point on the cover
9. Maximum weight of each removable panel section: 150 pounds
10. Maximum unit dead-load: 4 pounds per square foot
11. Maximum deflection: $L/240$ with L equal to the short span of the component
12. Lifting force per panel: Not to exceed the dead weight of the panel section
13. Load Combinations:
 - a. Dead Load and Live Load
 - b. Dead load and wind load (uplift)

D. Performance Requirements:

1. Each panel section removable without needing to remove more than two adjacent panel sections
2. Tank opening to be free and clear of any obstructions or structural elements once the panel sections are removed
3. Substantially watertight under all design load conditions and prevent water-ponding

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect covers from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack cover sections on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ultraflote, LLC – Houston, TX.
- B. Hallsten Corporation – North Highlands, CA
- C. Approved Equal

2.2 MATERIALS

- A. Structural Shapes: Aluminum alloy 6061-T6, 0.1 inch minimum thickness
- B. Miscellaneous shapes: Aluminum, alloy 6061-T6 or 6063-T5
- C. Bolts and fasteners: Type 316 Stainless steel
- D. Gaskets: Neoprene or Silicone, ASTM C509, ozone resistant

2.3 FABRICATION AND MANUFACTURE

A. General:

1. Design and fabrication of welded aluminum parts in accordance with Section 7 of the Aluminum Association's Specifications for Aluminum Structures, and the American Welding Society D1.2 Structural Welding Code for Aluminum.
2. All structural welds and weld-affected structural components inspected by the Dye Penetrant method of examination in accordance with AWS D1.2, Section 6, Part D.
3. No galvanized steel, painted, or plated steel shall be used anywhere in the cover system.
4. Dissimilar metals of the supporting structure isolated from the aluminum flat cover by means of a compatible elastomeric gasket.

B. Panels:

- C. Panels individually sealed along their edges with the tank and with adjacent panel sections using replaceable, elastomeric weather-seal gaskets.

D. Surface finish:

1. Integral bi-directional slip resistant surface that extends above the panel surface a minimum of 0.1 inch, or
2. Entire exposed outer surface of the cover finished with a non-anodized, integral non-skid surface, such as a mechanical matte finish M42 or coarser, as specified by the Aluminum Association.
3. Checker-plate or use of paint is not acceptable to obtain the surface finish specified.
4. Gaskets:
 - a. Form a substantially water and air tight seal along all panel edges
 - b. Shielded from exposure to sunlight

E. Lifting Device:

1. Provide two lifting handles, one at each end of each removable panel.
2. Lifting handles may be hinged plates with hand holes or recessed into the panel.
3. Lifting handles located within 9 inches of the end of the panel to prevent bodily injury while lifting.
4. Handles may not extend above the top surface of the panels when not being used, provide a smooth walk surface

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Confirm dimensions of all tank openings in the field prior to cover manufacture

3.3 INSTALLATION

- A. Install in accordance with manufacturers written instructions.
- B. Installation performed by personnel skilled in work of this kind.
- C. The cover installation checked, aligned, and approved by the manufacturer's factory trained representatives.
- D. Use stainless steel anchor bolts and stainless-steel clip fasteners to secure ends of panel sections to supporting members of prepared openings (concrete walkways or metal frame) to secure against uplift from wind.
- E. Set accurately in location, alignment and elevation, plumb, level, true and free of rack.
- F. Use of wedges or shimming devices is not acceptable.

3.4 FIELD QUALITY CONTROL

- A. Load Tests:
 - 1. Load test two panels per tank cover as a minimum.
 - 2. One panel subjected to two concentrated loads, consisting of cloth sacks of suitable size, containing earth or sand, applied simultaneously on two separate one-square-foot areas of the test panel.
 - 3. Each concentrated load not less than 1.5 times the concentrated closure panel design load specified.
 - 4. The second test panel shall be subjected to a uniform test load of 1.5 times the specified uniform closure panel design load applied over the entire surface of the panel.
 - 5. The test panels shall withstand the specified field test loads without damage, slippage or permanent distortion.
 - 6. If either test panel fails to meet the specified requirements, all closure panels shall be removed, replaced with new panels, and selected panels retested.
 - 7. Panel removal, replacement and retesting performed at no additional cost.
 - 8. Provide 24 hours' written advance notice of test to the Engineer.

END OF SECTION 44 33 11

SECTION 46 05 53 - IDENTIFICATION FOR WATER AND WASTEWATER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Labels.
5. Lockout devices.

B. Related Requirements:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this Section.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for equipment identification and schedule, including equipment number, location, function, and manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

- A. Metal Tags:

- a. Stainless steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 1 inch x 2-inch (minimum) with finished edges.

2.3 STENCILS

A. Description:

1. Clean-cut symbols.
2. Letter Height: 1-3/4 inch.

B. Stencil Paint: As specified in Section 09 90 00 - Painting and Coating; semi-gloss enamel.

2.4 LABELS

A. Description:

1. Laminated Mylar construction.
2. Minimum Size: 1.9 by 0.75 inch.
3. Adhesive backed, with printed identification.

2.5 LOCKOUT DEVICES

A. Lockout Hasps:

- a. Anodized aluminum construction.
- b. Furnish hasp with erasable label surface.
- c. Minimum Size: 7-1/4 by 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 90 00 - Painting and Coating for stencil painting.

3.2 INSTALLATION

- A. Identify equipment with nameplates.
- B. Identify inline pumps and other small devices with tags.

- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Apply stencil painting as specified in Section 09 90 00 - Painting and Coating.
- E. Install identifying devices after completion of coverings and painting.
- F. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- G. Labels:
 - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
- H. Install tags using corrosion-resistant chain.

END OF SECTION 46 05 53

SECTION 46 21 13 - CHAIN-AND-RAKE BAR SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanically cleaned, chain-and-rake type bar screens.
2. Screenings Sluice with screen and drain

B. Related Requirements:

1. Section 05 50 00 - Metal Fabrications: Miscellaneous metalwork and fasteners as required by this Section.
2. Division 26 - Electrical: Wiring connections to equipment.
3. Section 46 21 73 Screenings Washing and Compacting Equipment: Washer/Compactors furnished under this section of the specifications.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A320 - Standard Specification for Alloy-Steel and Stainless-Steel Bolting for Low-Temperature Service.

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for band screen materials and component equipment, including performance characteristics.

C. Shop Drawings:

1. Indicate system materials and component equipment, including detailed wiring and control diagrams.
2. Indicate complete information concerning fabrication, installation, anchoring, fasteners, and other details.
3. Indicate component materials, connections, and supports.

D. Manufacturer's Certificate:

1. Certify that screening equipment meets or exceeds specified requirements.
 2. Certify that installation is completed according to manufacturer instructions and that screens have been properly installed and tested and are ready for operation.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statements:
1. Submit qualifications for manufacturer and installer.
- H. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
1. Furnish one (1) set of manufacturer's recommended spare parts for each screen.
- C. Tools: Furnish special tools and other devices required for Owner to maintain screening components.

1.6 QUALITY ASSURANCE

- A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the machinery described in this section, the equipment manufacturer shall meet the requirements listed in this section.
- B. Manufacturer shall have a minimum of ten (10) years' experience with wastewater screenings systems.
- C. Screen(s) shall be Manufacturer's standard product and only modified as necessary to comply with the Drawings, Specifications, and specified service conditions.
- D. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

- E. Manufacturer shall provide screen, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. The screening system shall be appropriately crated and delivered to protect against damage during shipment.
- C. Inspection: Accept materials on Site in original packaging and inspect for damage.
- D. Store screen and components according to manufacturer instructions.
- E. Protect screen and components from water and wet weather.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish three-year manufacturer's warranty for screens and components. The screen supplier shall provide a three year service contract. The screen supplier shall provide as part of this service contract a certified service technician to visit the site every six months for the three year period. The service technician shall check each screen for proper operation, wear, make adjustments as needed, and perform training for staff.

PART 2 - PRODUCTS

2.1 CHAIN-AND-RAKE BAR SCREENS

- A. Manufacturers:
 - 1. Headworks International – Houston, TX (Base Bid)
 - 2. Vulcan Industries – Missouri Valley, IA
 - 3. Approved Equal
- B. Specifications and equipment arrangements for the screening equipment are based on the base bid manufacturer's equipment. Changes to the arrangement indicated in the specifications and in the plan, set shall be at the expense of the installing contractor. No change orders shall be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc.

2.2 DESIGN

- A. Description: Channel-mounted bar screens cleaned by chain-driven rake arm, which meshes with bar rack and travels up rack, cleaning and collecting trapped material; replaceable rake arm

carries trapped material up and out of wastewater channel, across a deadplate to discharge into a hopper; front-cleaning design to prevent rake from sliding over accumulated material; chain driven by top-mounted motor and head sprocket.

1. Inclination: 75 degrees from horizontal.
2. Frame: Integral self-supporting.
3. Discharge Wiper: Pivoted, brushless, automatic, self-positioning wiper with return to rest; replaceable UHMW wiper blades.
4. Foot Shaft Sprockets: Mounted on idlers without external lubrication.
5. Bar Type: Rectangular.
6. Enclosure: Full covers and enclosed discharge chutes.

B. Performance and Design Criteria:

1. No deflection, damage, or distortion by loads imposed by 5-foot water differential between upstream and downstream side of bar rack at maximum water depth in downstream channel.
2. No obstructions in sewage channel except bar rack and rake arm.
3. Structural supports and fasteners, except bar rack supports, located above maximum water level.

PERFORMANCE CRITERIA (SCR1010, SCR1020)	
Peak Flow Rate (MGD)	27
Average Flow Rate (MGD)	13.5
Minimum Flow Rate (MGD)	6.5
Channel Width (Ft.)	5
Channel Depth (Ft.)	SEE PLANS
Maximum Upstream Water Depth (inches) @ Peak Flow	2
Design % Screen Blinding	30%
Headloss @ Design Blinding (inches)	21
Maximum Upstream Water Level (inches)	72
Minimum Motor Size (HP)	2.0
Bar Rack Opening Size (inches)	0.25
Screen Discharge Height (feet)(Above Operating Floor Level	5'-0"

DESIGN CRITERIA (SCR1010, SCR1020)	
Number of Chain & Rake Screens	2
Inclination angle	75 degrees
Bar rack bar size	5/16" x 1/4" x 1-1/2"
Bar rack bar profile	Tapered

Rake speed	20 feet / minute
Roller chain pitch	6 inch
Roller chain side plate material	316 SST
Roller chain roller, pin, bushing material	17-4 SST
Roller chain ultimate strength (per chain)	16,000 lb _f
Screen drive reducer type	Helical Bevel
Screen drive reducer ratio	380:1
Screen motor / control panel voltage	460 volts
Screen motor / control panel phase	3 ph
Screen motor / control panel frequency	60 Hz
Main control panel enclosure rating	NEMA 4X
Local control station enclosure rating	NEMA 7

C. COMPONENTS

1. Chain, Sprockets and Drive Shaft Assemblies

- a. The chains shall be roller type with stainless steel side plates. The rollers, pins and bushings shall be hardened stainless steel.
- b. The stainless-steel drive shaft shall be supported on each side by grease lubricated take-up bearing assemblies.
- c. The chain shall track in a stainless-steel guide system mounted in each side frame.
- d. The bottom sprockets shall be mounted on hardened 304 stainless steel stub shafts mounted to the side frame. The sprockets shall have Ertalyte® bushing for long life and wear.

2. Side Frames

- a. The screen shall include side frames and bracing designed to support the chain, rakes, spray wash, discharge, and drive assemblies.
- b. Each side frame shall be designed to house the replaceable stainless steel and UHMW polyethylene tracking system.
- c. The bottom tracking system shall consist of a stainless-steel inner and outer rings.

3. Covers

- a. The portion of the screen above the operating floor level shall have stainless steel covers.
- b. The covers shall provide quick access to the equipment for maintenance.

4. Drive Assembly

- a. The screen drive assembly shall be a shaft-mounted reducer with an electric motor. The reducer type, ratio, motor rating, and characteristics shall be as specified in the Design Criteria.
5. Wiper
 - a. The wiper shall be stainless steel, pivoting and be easily adjustable.
 - b. The wiper shall have a replaceable UHMW polyethylene blade.
6. Bar Rack
 - a. Bars shall be stainless steel and shaped as specified in the Design Data section, items 3, 4. The bar rack shall extend 18" above the max water level unless noted.
 - b. The bar spacing shall be as specified in the Design Criteria. The bars shall be supported as required.
 - c. Each bar of the bar rack shall be removable from the bar rack assembly. Bars shall not be welded in place.
7. Rakes
 - a. The stainless-steel rakes shall be constructed of two or more pieces and are bolted to the stainless-steel chain on each side.
 - b. The stainless-steel rake frame is designed to fasten to, support, and align the rake teeth.
 - c. The stainless-steel rake teeth shall be machined in sections and designed to fasten to the rake frame.
8. Apron and Dead Plate
 - a. The apron and dead plate shall be stainless steel.
9. Discharge Chute
 - a. The discharge chute shall receive screened debris that has been removed from the rakes by the wiper.
 - b. An enclosed stainless-steel discharge chute shall transport the discharge to a sluiceway, compactor or container.
10. Screenings sluice
 - a. The screenings sluice shall receive screened debris from the screen discharge chute and convey it to the washer compactor.
 - b. An enclosed stainless-steel discharge chute shall transport the discharge to a compactor.
 - c. Spray Water Control Assembly:
 - 1) Filters, controls and regulates sluice water.
 - 2) Delivery, frequency and duration: Programmable through the controller.
 - 3) Basket strainer: Primary filtration of sluice water with 20 mesh screen.
 - a) Construction: AISI 316 housing with AISI 304 stainless steel Screen.
 - 4) Y-Strainer: Secondary filtration of sluice water with 80 mesh screen.
 - 5) Basket strainer: Primary filtration of sluice water with 20 mesh screen.
 - a) Construction: AISI 316 housing with AISI 304 stainless steel Screen.
 - 6) Solenoid Valves: Control flow of sluice water with 120VAC coil, explosion proof.

- 7) Ball Valves: Manual regulation of water flow and shut off.
 - a) Construction: AISI 316 Stainless steel.
- 8) Pressure Gauge: Visual indication of operating pressure.
 - a) Freeze resistant design.
 - b) Range: 0-160 PSI
- d. The sluice shall include a screened drainage area for removing sluice water from the screening prior to discharge to the compactor.
- e. Provide a 6-inch flanged drain outlet for the screened drain area of the sluice.

2.3 CONTROLS

A. COMPONENTS

1. PLC shall be an Allen Bradley model Micrologix 1400
2. OIT shall be an QSI model QTERM-A7
3. Circuit Breakers shall be Siemens
4. Starters shall be Allen Bradley IEC
5. Relays shall be Allen Bradley and/or IDEC
6. Pilot lights shall be Allen Bradley 22mm Type 4/4X/13
7. Selector switches shall be Allen Bradley Type 4/4X/13
8. Ultrasonic differential level system shall be Endress & Hauser
9. The panel shall include a Hirschmann Model Gecko 4TX Managed Ethernet Switch and Hirschmann Model OZD 485 G12 BAS 943893321 Fiber Interface to provide connectivity to the plant-wide SCADA System furnished by others

B. CONTROL PANEL

1. The main control panel (FCP1010) shall be mounted remotely to the screens and contain the following switches and lights:
 - a. Reset push button
 - b. Power on light
 - c. Screen run light
 - d. Alarm light (overload)
2. The local control station shall be mounted locally to the screen and contain the following:
 - a. Hand/Off/ Auto selector switch for each screen and sluice water solenoid valve
 - b. Forward /Off/Reverse selector switch, spring returned in reverse
 - c. Emergency Stop push button
 - d. Interface to Washer/Compactor controls furnished under Section 46 21 73.
3. Ratings for the main control panel and local control station enclosures shall be as specified in the Design Criteria.

2.4 OPERATION

- A. When the screen is in the Hand mode and in the Forward position the screen shall run continuously. The Reverse position is spring loaded and shall only operate in the Hand mode. The sluice water solenoid shall be controlled by the screen control panel.
- B. In the Auto Mode the screen cycle shall start by a signal from one of the following:
 - 1. Differential level system
 - 2. Timer (backup)
 - 3. Input error from transducer (loss of echo)
 - 4. High level alarm
 - 5. High level start
- C. If the screen starts by differential level the screen shall run until the differential drops below the set point and the off-timer times out.
- D. If the screen starts on high level it shall run until the high-level drops below the set point and the off timer times out.
- E. If the one of level transducers has an error the screen shall run continuously.
- F. The screen also has a backup timer that shall allow the screen to operate periodically during periods of low activity. The timer is adjustable for both start frequency and duration of run

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout, orientation, and connections.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Comply with all OSHA, local, state, and federal codes and regulations.

3.3 FACTORY TESTING

- A. The screening system and all components shall be factory assembled and tested prior to shipment. The equipment shall be shipped fully assembled and shall be capable of being set in place and field erected by the Contractor with minimal field assembly.
- B. During the factory test period the screening system shall be adjusted as required assuring proper operation on completion of the field installation. The Manufacturer shall supply a certification of the completion of the factory testing of the assembled screening system and appurtenances and shall certify as to the equipment being in satisfactory operating condition at time of

shipment. The Engineer and/or Owner may, at their own option and expense, witness the factory test.

3.4 DELIVERY AND STORAGE

- A. The screening system shall be appropriately crated and delivered to protect against damage during shipment.
- B. An authorized representative of the Contractor shall inspect the screens on delivery to the jobsite and shall report any damage or missing components to the Manufacturer and the Engineer within 72 hours of receipt of the shipment.

3.5 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2), 8 hour days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- C. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.6 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, on-line operations, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 21 13

SECTION 46 21 73 - SCREENINGS WASHING AND COMPACTING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Screenings washer/compactors.

B. Related Requirements:

1. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment: Execution requirements for motors specified in this Section.
3. Section 46 05 53 - Identification for Water and Wastewater Equipment: Nameplates for equipment specified in this Section.
4. Section 46 21 13 - Chain-And-Rake Bar Screens: Equipment Interface.

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A36 - Carbon Steel Plate.
2. ASTM A536 - Ductile Iron Castings.
3. ASTM A48 - Gray Iron Castings.
4. ASTM Grade 630 (UNS S17400) Stainless Steel.

B. American Iron and Steel Institute (AISI):

1. AISI Type 4130 - Heat Treated Alloy Steel.
2. AISI Type 4140 Heat Treated Alloy Steel.
3. AISI Type 1045 Steel.
4. AISI Type 303 Stainless Steel.
5. AISI Type 304 Stainless Steel.
6. AISI Type 316 Stainless Steel.

C. Society of Automotive Engineers (SAE):

1. SAE Type 660 Bearing Bronze.

D. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
 - 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.
- G. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.4 QUALITY ASSURANCE

Products furnished under this section shall be provided by the Screening Equipment supplier specified in Section 46 21 13.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations of installed screenings washer/compactors.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts.
- C. Tools: Furnish special tools and other devices required for Owner to maintain screenings washing and compacting equipment.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept screenings washer/compactors on-Site in original packaging. Inspect for damage.
- D. Store materials according to manufacturer's instructions.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for screenings washer/compactors and accessories.

PART 2 - PRODUCTS

2.1 SCREENINGS WASHER/COMPACTORS

A. Manufacturers:

- 1. Shall be provided by the Bar Screen Manufacturer

B. Description:

- 1. Washer/compactor washes out organics and dewater screenings in an automatic sequence.
- 2. Screenings enter top of unit and are agitated by a rotating screw under a spray of wash water.
- 3. Washed screenings are transferred into a compactor section, then conveyed through a discharge pipe.
- 4. Washer/compactor consists of wash water motor, screenings screw, compactor with motor, discharge assembly, and other components to make a complete and operable system.

C. Basis of Design:

- 1. Number of Units: 1
- 2. Equipment Tags: SWC1030
- 3. Drive System: Electric Motors and Controller.
- 4. Discharge Drain Connections: Two 4 inch Female NPT

5. Maximum Solids Capacity (Continuous): 40 ft³/hr.
 6. Maximum Solids Capacity (Batch): 78 ft³/hr.
 7. Maximum Water (Launder) Capacity: 160 GPM including Wash Press spray water.
- D. Wash Tank:
1. Tank with removable cover and end plates, allow for removal or installation of compaction screw from either end or above.
 2. Inspection ports and covers: Three ports for viewing, located on either side of tank and on top cover.
 3. Spray water manifolds: Spray pipes located on either side of perforated screen for washing of material.
 4. Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- E. Perforated Screen:
1. Screen provides separation of solids and water through use of perforated holes that control particle size throughput.
 2. Screen removable from tank through use of fasteners.
 3. Screen perforated hole diameter shall be 1/4 inch (6mm) with 40% open area, Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- F. Spray Water Control Assembly:
1. Filters, controls and regulates spray water to the tank spray water manifold.
 2. Filters, controls and regulates spray water to the Hopper spray water manifold.
 3. Delivery, frequency and duration: Programmable through the controller.
 4. Basket strainer: Primary filtration of spray water with 20 mesh screen.
 - a. Construction: AISI 316 housing with AISI 304 stainless steel Screen.
 5. Y-Strainer: Secondary filtration of spray water with 80 mesh screen.
 6. Basket strainer: Primary filtration of spray water with 20 mesh screen.
 - a. Construction: AISI 316 housing with AISI 304 stainless steel Screen.
 7. Solenoid Valves: Control flow of water to manifolds with 120VAC coil, explosion proof.
 8. Ball Valves: Manual regulation of water flow and shut off.
 - a. Construction: AISI 316 Stainless steel.
 9. Pressure Gauge: Visual indication of operating pressure.
 - a. Freeze resistant design.
 - b. Range: 0-160 PSI
 10. Reinforced Hose: Connects Wash Water Control Assembly to spray water manifolds.
- G. Paddle Compaction Screw:
1. Screw design provides disruptive movement of the material creating a turning or flipping action that enhances the wash process by continually exposes additional surface area to the wash water. Compaction screw constructed with specific purpose flight zones for pre-wash zone, wash zone and compaction zone.
 2. Pre-wash zone flights: 12 inch outer diameter with 1/4 inch thick sectional flights.

No brush shall be used in this zone to prevent solids buildup.
 3. Wash zone flights: 12 inch outer diameter with 1/4 inch thick sectional flights and three 3/8 inch thick paddle sections for disruptive movement of material.
 - a. Flight brush segmented for each full pitch of spiral to scrub perforations in wash zone.
 - 1) Base: HDPE
 - 2) Bristles: Level cut nylon

- b. Paddle brush segmented for each paddle
 - 1) Base: HDPE
 - 2) Bristles: Crimped nylon
 - 4. Compaction zone flights: Dual helix design 11-1/4 inch diameter with a nested 1 inch thick outer spiral and a 1/2 inch thick inner spiral.
 - a. Second helix for one full pitch of spiral.
 - b. Hard face weld applied with two layers to face of dual helix flights.
 - 5. Torque Tube: 3 inch diameter tube inserted and welded through center of all flight zones.
 - a. End of tube with dome shaped protrusion to create “donut” form of solid plug in compaction zone for easier transport.
 - b. Hard face weld applied with two layers to dome.
- H. Compaction Elbow:
 - 1. 60-degree bend aiding formation of solids plug and inclined to lift solids to discharge point.
 - 2. Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- I. Tapered Transport Tube:
 - 1. Transport tube tapered 12-1/2 inch diameter to 13-5/8 inch diameter to allow for reduced restriction on movement of capered solids and allow proper air flow to further dry material.
 - 2. Tapered transport tube length: as required by layout and discharge location.
 - 3. Transport tube lifting bracket designed to lift tube empty or full with solids.
 - 4. Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- J. Straight Transport Tube:
 - 1. Transport tube 13-5/8 inch diameter provides additional length to discharge.
 - 2. Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- K. Discharge Tip:
 - 1. Tip mounts to end of tapered transport tube or straight transport tube to directional discharge material plug in a downward direction.
 - 2. Construction Material: AISI 304 stainless steel. Passivated with glass bead blast finish.
- L. Shaft Seal:
 - 1. Provides sealing for Paddle Compaction screw shaft and wash tank.
 - 2. Tungsten carbide dynamic and static seals faces.
 - 3. Bearing provides support for axial thrust loads.
 - 4. Static and dynamic race housings: AISI 304 stainless steel.
 - 5. Elastomers: BUNA-N (Nitrile).
- M. Speed Reducer:
 - 1. Manufacturer: Radicon
 - 2. Reduction ratio and design: 123.3:1, helical bevel shaft mounted.
 - 3. Lubrication: Synthetic oil.
- N. Motor:
 - 1. TEFC Motor: Baldor Electric Company

- a. Installed Horsepower: 5 HP.
- b. RPM: 1750.
- c. Motor Service Factor: 1.00 minimum
- d. Motor Efficiency Factor (at full load): 89.5 minimum
- e. Motor Power Factor (at full load): 78

2.2 WASHER/COMPACTOR CONTROLLER (FCP1040)

- A. Motor Controller: Each Washer/Compactor shall be equipped with a controller.
 1. Number of Motor Controllers: 1.
 2. Equipment Designation: FCP1030
 3. Motor Control Power: 460 VAC/ 3 PH/ 60 Hz.
 4. Enclosure: 304 S/S NEMA 4X.
 5. Functionality:
 - a. Programmable operation of washing & compacting equipment.
 - b. Run Permissive: Signal to motor controller indicating activity of upstream equipment.
 - c. Accumulated Feed Time: Minimizes operation and creates uniform batch loading into the system.
 - d. Programmable Run Sequences: Comprised of a sequence of time elements controlling auger behavior to optimize washing and compacting based on motor power consumption.
 - e. Power Monitor: Identifies real time auger motor power consumption to determine appropriate stage parameters to execute next run cycle.
 - f. Wash Water Duration and Frequency: Fully programmable and adjustable through stages of operation.
 - g. Repeat Function: Reoccurring run sequence for multiple solids washing sequences.
 6. Auger ON-OFF-AUTO three-position selector switch.
 - a. OFF Position: Washing & compacting equipment shall not run.
 - b. ON Position: Washing & compacting equipment shall run continuously forward.
 - c. AUTO Position: Washing & compacting equipment shall operate device in accordance with pre-configured operating parameters as controlled by a Run Permissive signal from an upstream feed device.
 - 1)
 7. Pilot Lights: 22 mm LED type rated NEMA 4X.
 - a. Indicate auger run and fail.
 8. Reset Pushbutton: 22mm momentary and rated NEMA 4X.
 - a. Resets system after fail.
 9. Emergency Stop Pushbutton:
 - a. Rating: NEMA 4X.
 - b. Stops all motors and de-energizes solenoid valves.
 10. Motor Starters:
 - a. IEC full voltage reversing type with 120 VAC operating coils.
 - b. Integrated, adjustable overload relays sized to full load amperes (FLA) of the motor (see Power Monitor).
 - c.
 11. Programmable Logic Controller: Manufactured by Allen-Bradley.
 - a. Model: Micro820.
 12. Power Monitor: Allen-Bradley E300 intelligent motor overload relay.

- a. Adjustable overload relay functionality sized to motor full load amperes (FLA).
 - b. Provides full-scale auger motor power demand to PLC to determine proper run cycle.
 - 13. Operator Interface Terminal (OIT): Operation, display and programming.
 - a. Manufacturer: Allen-Bradley.
 - b. Model: Panelview 800 with 4-inch display.
 - c. Indicator lights, switches and other control devices.
 - d. Includes interface for a minimum 512 MB industrial grade compact flash card.
 - e. Monitoring Display:
 - 1) Auger: Running or stopped.
 - 2) Run cycle.
 - 3) Auger power demand.
 - 4) Spray Valve: Open or closed.
 - 5) Running failure.
 - 6) Service reminder and operational messages.
 - f. Password-protected screens allow configuration of:
 - 1) Date and time.
 - 2) Auger start parameters.
 - 3) Auger stage run cycle parameters
 - 4) Wash tank spray water stage parameters
 - 5) Stage power demand values.
 - 14. Operation:
 - a. Auger Jam occurs while system is running:
 - 1) Controller stops and reverses auger rotation to clear obstruction.
 - 2) If Jam clears:
 - a) Controller returns auger to normal operation.
 - 3) If two reverses occur within a 30 second interval:
 - a) Controller de-energizes auger motor and activates auger FAIL indicator and relay.
 - b. Power Failure While Operating:
 - 1) System returns to normal operation once power is restored, running as dictated by the permissive and programmed run sequence.
 - c. Power Failure While Auger is in Fail Condition: Once power is restored the fail indicator reactivates and remain until reset.
 - 15. Local control station: ON and OFF control for washing & compacting equipment in a hazardous location local to the equipment.
 - a. Enclosure: Cast aluminum NEMA 7 rated.
 - b. Washing and compacting equipment ON-OFF two position explosion proof rated selector switch.
 - c. When Main Controller is in REMOTE position:
 - 1) Washing & compacting equipment shall be started and stopped using selector switches on the main controller.
 - d. When Main Controller is in LOCAL position:
- B. Washing & compacting equipment shall be started and stopped using selector switches on local control station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that screenings discharge equipment is installed and ready to receive washer/compactors.

3.2 INSTALLATION

- A. Install screenings washer/compactors according to manufacturer's instructions and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. After installation, inspect and test for proper operation.
- C. Manufacturer Services: See requirements of Section 46 21 43.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Check control functions and adjust as required.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 21 73

SECTION 46 33 33 - POLYMER BLENDING AND FEED EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polymer blending unit and feed system.
2. Booster and metering pumps.
3. Skid-mounted support, frame, and floor stand.
4. Valves and piping appurtenances.
5. Flow meters.
6. System control panel.
7. Control features.

B. Related Requirements:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this Section.
2. Section 22 11 00 - Facility Water Distribution: Water service piping.
3. Section 26 05 03 - Equipment Wiring Connections: Wiring connections to equipment.
4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Wire and cable rated 600 V and less.
5. Section 26 05 53 - Identification for Electrical Systems: Identification methods for electrical equipment and components.
6. Section 26 29 23 - Variable-Frequency Motor Controllers: Requirements for motors equipped with variable-frequency drives.
7. Section 40 05 07 - Hangers and Supports for Process Piping: Piping restraints.
8. Section 40 05 93 - Common Motor Requirements for Process Equipment: Common requirements for motors required under this Section.
9. Section 40 42 13 - Process Piping Insulation: Insulating requirements for piping required by this Section.
10. Section 40 42 23 - Process Equipment Insulation: Insulating requirements for equipment specified in this Section.
11. Section 40 67 00 - Control System Equipment Panels and Racks: Process control panel and components.
12. Section 46 05 48 - Vibration and Seismic Controls for Water and Wastewater Equipment: Requirements for isolation of equipment and components.
13. Section 46 74 01 - Sludge Dewatering Screw Press Equipment: Sections under which one of these systems is provided.

1.2 REFERENCE STANDARDS

A. ASME International:

1. ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information, including system materials and component equipment.
- C. Shop Drawings:
 - 1. Submit detailed wiring and control diagrams.
 - 2. Indicate fasteners, anchors, and fabrication details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions regarding installation requirements, including storage and handling procedures, special field procedures, anchoring, and layout.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.6 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for polymer blending and feed equipment.

1.8 DESIGN CRITERIA

- A. Polymer Type: Emulsion
- B. Polymer Activity (% active): 30-75
- C. Solution Concentration Range: 0.1% to 1.0%
- D. Flow Ranges – Sludge Dewatering Press
 1. Neat Polymer: 0.5-10.00 GPH
 2. Dilution Water: 180-1,800 GPH

1.9 SPARE PARTS & SPECIAL TOOLS

- A. One (1) progressive cavity pump stator
- B. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.
- C. Provide one (1) neat polymer check valve, complete

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. VeloDyne of Louisville, CO
- B. UGSI of Vineland, NJ
- C. ProMinent of Pittsburg, PA
- D. Approved Equal

2.2 MATERIALS

- A. Material Requirements:

1. System skid: 304 stainless steel
2. Hardware: Type 18-8 stainless steel.
3. Piping & pipe fittings: schedule 80 PVC
4. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
5. Water solenoid valve: brass
6. Pressure gauges: stainless steel, liquid filled
7. Pressure switches: NEMA 4, brass connection
8. Flow meter: acrylic, stainless steel, PVC and or polypropylene
9. Water control valve: stainless steel with stainless steel seat
10. Mixing chamber body / flanges: stainless steel
11. Mixing chamber cover / chamber: clear polycarbonate
12. Impeller: 304 stainless steel
13. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
14. Mixing chamber pressure relief valve: brass, stainless steel or PVC
15. Metering pump wetted parts: stainless steel & Viton
16. Seals: Viton, ceramic, Teflon, and or carbon
17. Control enclosure: 304 stainless steel.

2.3 EQUIPMENT

A. Polymer Activation & Blending Chamber:

1. These specifications are based on a multi-stage, multi-zone, Hydro-Mechanical polymer activation & blending technology. Alternate technologies will only be considered if proven to provide an equal level of performance, versatility, reliability and quality, otherwise the following technology will be provided without exception.
2. In order to provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage Hydro-Mechanical polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:
 - a. Non-Mechanical Stage: The device shall be capable of activating and blending polymer based on plant water pressure at 30 psig or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases.
 - b. Hydro-Mechanical mixing Stage: In addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless-steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra-high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.
 - c. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely

on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

3. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.
4. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.
5. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.
6. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement.
7. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.
8. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

B. Dilution Water Assembly:

1. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified under "Design Criteria" above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.
2. The unit shall have a linear actuated variable rate control valve to automatically proportion water flow to polymer flow for polymer / water ratio control. Valves that diminish mixing energy in the non-mechanical stage shall not be used.
3. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.
4. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 25 and 100 psig. Proof pressure shall be 500 psi minimum. The pressure switch shall be as manufactured by Ashcroft.
5. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure and a stainless steel FNPT water inlet connection.

C. Progressive Cavity Neat Polymer Metering Pump

1. The unit shall have one (1) neat polymer metering pump(s) integrally mounted on the systems skid. The metering pump(s) shall have a range as specified under “Design Criteria” above. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be packing type, mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel.
2. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable.
3. Provide loss of polymer flow sensor.

D. Solution Discharge Assembly:

1. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure and a stainless steel FNPT discharge connection.

E. Control Panel:

1. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of 304 stainless steel. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.
2. Power: 120 VAC, 1Ph, 60/50 Hz. with a main power rotary style disconnect switch.
3. A circuit breaker on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.
4. The controller shall have a minimum 5.7” TFT touch screen. Systems that rely on microprocessors and or alphanumeric displays shall not be considered.
5. Operator Interface – 5.7” Minimum TFT touch screen with the following features as a minimum:
 - a. LOCAL / REMOTE start/stop mode select:
 - 1) LOCAL start/stop mode: System shall run based on operator input from touch panel start/stop push-button.
 - 2) REMOTE start/stop mode: System shall start and stop according to the state of remote dry contacts (closed = run, open = stopped).
 - b. MANUAL / PROPORTIONAL AUTO operational mode select.
 - 1) MANUAL mode: The desired water flow is set manually using increase/decrease push-buttons on touch panel. The desired polymer flow is set manually using increase/decrease push-buttons on touch panel. Solution concentration defined by water and polymer settings.
 - 2) MANUAL mode run screen features:
 - a) Water control increase/decrease push-buttons.
 - b) Water flow rate (GPH) display.

- c) Polymer control increase/decrease push-buttons
- d) Polymer flow rate (GPH) display.
- e) Solution concentration (% poly) display.
- f) Total solution flow rate (GPH)
- c. Flow Paced Mode:
 - 1) Water flow adjusts automatically to maintain operator desired solution concentration.
 - 2) Polymer flow paced by remote 4-20mA (supplied by others).
 - 3) Desired solution concentration adjusted manually using increase/decrease push-buttons on touch panel.
 - 4) PACED POLY RATIO mode run screen features:
 - a) Water flow rate (GPH) display.
 - b) Remote pacing signal level (mA)
 - c) Polymer flow rate (GPH) display.
 - d) Solution concentration control increase/decrease push-buttons.
 - e) Desired solution concentration (% poly) display.
 - f) Solution concentration (% poly) display.
 - 5) Help Screens:
 - a) For each mode of operation
 - 6) Alarm screen features:
 - a) Indication of alarm
 - b) Description of recommended corrective action
 - c) Reset
 - d) Alarm history
 - e) Set-up screen features:
 - f) Semi-auto pump calibration
 - g) System flush settings
 - h) Auxiliary alarm user programming mode
 - 7) Discrete Selector Switch & System Indicator:
 - a) Main Power ON /OFF Switch
 - b) Main Power ON indicator
 - 8) Inputs (signals by others):
 - a) Remote Start / Stop (discrete dry contact)
 - b) Pacing Signal Based on Process Flow (4-20mA)
 - 9) Outputs:
 - a) System Running (discrete dry contact)
 - b) Remote Mode (discrete dry contact)
 - c) Common Alarm (discrete dry contact)
 - d) Polymer Pump Rate (4-20mA)
 - 10) Communication: Ethernet/IP

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

- B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Piping:
 - 1. Provide flexible connectors in piping connections to vibrating equipment.
 - 2. Harness or anchor flexible connectors as necessary.
- C. Clean field welds to remove slag and splatter to provide a smooth surface.
 - 1. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment, as indicated on Drawings.
 - 2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
 - 3. Supports:
 - a. Construct piping supports of 304 stainless steel members.
 - b. Brace and fasten with flanges bolted to equipment structure.
- D. Provide rigid anchors for pipes after vibration isolation components have been installed.
- E. Install insulation as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Field Testing:
 - 1. Test for proper alignment.
 - 2. Demonstrate operation without undue noise, vibration, or overheating.
 - 3. Engineer will witness field testing.
- C. Control System: Energize system equipment and test operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Engineer.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one (1) trip two (2) eight (8)

hour days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 33 33

SECTION 46 33 33 - POLYMER BLENDING AND FEED EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polymer blending unit and feed system.
2. Booster and metering pumps.
3. Skid-mounted support, frame, and floor stand.
4. Valves and piping appurtenances.
5. Flow meters.
6. System control panel.
7. Control features.

B. Related Requirements:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this Section.
2. Section 22 11 00 - Facility Water Distribution: Water service piping.
3. Section 26 05 03 - Equipment Wiring Connections: Wiring connections to equipment.
4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Wire and cable rated 600 V and less.
5. Section 26 05 53 - Identification for Electrical Systems: Identification methods for electrical equipment and components.
6. Section 26 29 23 - Variable-Frequency Motor Controllers: Requirements for motors equipped with variable-frequency drives.
7. Section 40 05 07 - Hangers and Supports for Process Piping: Piping restraints.
8. Section 40 05 93 - Common Motor Requirements for Process Equipment: Common requirements for motors required under this Section.
9. Section 40 42 13 - Process Piping Insulation: Insulating requirements for piping required by this Section.
10. Section 40 42 23 - Process Equipment Insulation: Insulating requirements for equipment specified in this Section.
11. Section 40 67 00 - Control System Equipment Panels and Racks: Process control panel and components.
12. Section 46 05 48 - Vibration and Seismic Controls for Water and Wastewater Equipment: Requirements for isolation of equipment and components.
13. Section 46 74 01 - Sludge Dewatering Screw Press Equipment: Sections under which one of these systems is provided.

1.2 REFERENCE STANDARDS

A. ASME International:

1. ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay).

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information, including system materials and component equipment.
- C. Shop Drawings:
 - 1. Submit detailed wiring and control diagrams.
 - 2. Indicate fasteners, anchors, and fabrication details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions regarding installation requirements, including storage and handling procedures, special field procedures, anchoring, and layout.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.6 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

1.7 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for polymer blending and feed equipment.

1.8 DESIGN CRITERIA

- A. Polymer Type: Emulsion
- B. Polymer Activity (% active): 30-75
- C. Solution Concentration Range: 0.1% to 1.0%
- D. Flow Ranges – Sludge Dewatering Press
 1. Neat Polymer: 0.5-10.00 GPH
 2. Dilution Water: 180-1,800 GPH

1.9 SPARE PARTS & SPECIAL TOOLS

- A. One (1) progressive cavity pump stator
- B. One (1) banding clamp tool for replacement of the progressive cavity metering pump pin joint banding clamps.
- C. Provide one (1) neat polymer check valve, complete

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. VeloDyne of Louisville, CO
- B. UGSI of Vineland, NJ
- C. ProMinent of Pittsburg, PA
- D. Approved Equal

2.2 MATERIALS

- A. Material Requirements:

1. System skid: 304 stainless steel
2. Hardware: Type 18-8 stainless steel.
3. Piping & pipe fittings: schedule 80 PVC
4. Tubing and tube fittings: polyethylene, polypropylene, stainless steel and Viton
5. Water solenoid valve: brass
6. Pressure gauges: stainless steel, liquid filled
7. Pressure switches: NEMA 4, brass connection
8. Flow meter: acrylic, stainless steel, PVC and or polypropylene
9. Water control valve: stainless steel with stainless steel seat
10. Mixing chamber body / flanges: stainless steel
11. Mixing chamber cover / chamber: clear polycarbonate
12. Impeller: 304 stainless steel
13. Impeller shaft seal: Viton, stainless steel, ceramic, carbon
14. Mixing chamber pressure relief valve: brass, stainless steel or PVC
15. Metering pump wetted parts: stainless steel & Viton
16. Seals: Viton, ceramic, Teflon, and or carbon
17. Control enclosure: 304 stainless steel.

2.3 EQUIPMENT

A. Polymer Activation & Blending Chamber:

1. These specifications are based on a multi-stage, multi-zone, Hydro-Mechanical polymer activation & blending technology. Alternate technologies will only be considered if proven to provide an equal level of performance, versatility, reliability and quality, otherwise the following technology will be provided without exception.
2. In order to provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage Hydro-Mechanical polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:
 - a. Non-Mechanical Stage: The device shall be capable of activating and blending polymer based on plant water pressure at 30 psig or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is no way diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases.
 - b. Hydro-Mechanical mixing Stage: In addition to the non-mechanical mixing stage the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless-steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra-high, non-damaging mixing energy at all flow rates. This shall be accomplished by controlling mixing intensity and preventing over exposure to, or damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and to effectively inducing high, non-damaging mixing energy over the systems full flow range.
 - c. Mixers that rely solely on plant water pressure and or flow for mixing energy will not be acceptable. Mixers where performance is affected by flow rate and therefore retention time resulting in under or over exposure to mixing energy, or which rely

on constant speed impellers or that rely on close tolerances for blending shall not be acceptable.

3. In order to prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber - at no time shall there be low velocity within any portion of the mixing chamber.
4. The mixing impeller shall be controlled by an SCR motor controller and driven by a wash-down duty motor. The motor shall be mounted horizontally or above the mixing chamber. Motors mounted under the mixing chamber where seal failure or leaks can damage the motor shall not be acceptable.
5. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. Systems without a seal flushing system shall not be considered. All bearings shall be external from the mixing chamber. Internal bearings shall not be acceptable.
6. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe shall not be acceptable to meet this requirement.
7. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a pressure relief on the mixing chamber factory set at 75 psi.
8. Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. To minimize check valve plugging due to normally occurring polymer agglomerations, the minimum open area up to and including the valve seat shall be 3/16" without exception. The valve body shall be constructed of Teflon with Viton seals. The valve poppet and spring shall be stainless steel. The spring shall be outside of the polymer flow path to prevent build-up and plugging. The locking pin used to hold the valve in place shall be attached to the mixing chamber with a lanyard. The valve shall be readily accessible for cleaning and shall not require tools for removal, cleaning or replacement. Conventional check valves, valves that rely on ball seals, and or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing will not be accepted.

B. Dilution Water Assembly:

1. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range as specified under "Design Criteria" above. Unions or flanges shall be provided on the flow meter to allow easy removal for cleaning.
2. The unit shall have a linear actuated variable rate control valve to automatically proportion water flow to polymer flow for polymer / water ratio control. Valves that diminish mixing energy in the non-mechanical stage shall not be used.
3. The unit shall have an electric solenoid valve for on/off control of total dilution water flow.
4. A differential pressure type low water differential pressure alarm shall be provided. The switch shall be adjustable between 25 and 100 psig. Proof pressure shall be 500 psi minimum. The pressure switch shall be as manufactured by Ashcroft.
5. Provide a 2-1/2" stainless steel liquid filled pressure gauge to monitor dilution water inlet pressure and a stainless steel FNPT water inlet connection.

C. Progressive Cavity Neat Polymer Metering Pump

1. The unit shall have one (1) neat polymer metering pump(s) integrally mounted on the systems skid. The metering pump(s) shall have a range as specified under “Design Criteria” above. The pump shall be a positive displacement, progressive cavity type constructed of stainless steel and Viton. The shaft seal shall be packing type, mechanical seals shall not be used. A 90 VDC wash-down duty motor shall drive the pump. A gear reducer shall be provided to produce a maximum pump shaft speed of not more than 545 RPM. The motor shall be controlled by an SCR motor controller located in the system control panel.
2. Provide a calibration column with two full port PVC ball valves having Viton o-rings. The column shall be calibrated for a one minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the systems frame with a minimum of two heavy duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable.
3. Provide loss of polymer flow sensor.

D. Solution Discharge Assembly:

1. Provide a 2-1/2” stainless steel liquid filled pressure gauge to monitor system discharge pressure and a stainless steel FNPT discharge connection.

E. Control Panel:

1. A control panel integral to the systems frame shall be provided. The enclosure shall be rated NEMA 4X and constructed of 304 stainless steel. The control panel shall consist of all controllers, digital displays, potentiometers, switches, lights, relays, and other control devices required for a complete operable system. The control panel and all components shall be industrial duty. All skid mounted electrical components interconnected to the control panel shall terminate at numbered and labeled terminal blocks. The terminal blocks shall be sized for 14 ga. wire. Wires shall be neatly run through wire race-way and numbered with shrink tubing type labels. Adhesive labels shall not be used. The control panel shall be positioned such that there are no obstructions in front of the control panel per related NFPA requirements. Control.
2. Power: 120 VAC, 1Ph, 60/50 Hz. with a main power rotary style disconnect switch.
3. A circuit breaker on the main control circuit and on each motor shall be provided as manufactured by Allen Bradley or equal. Fuses shall not be used for circuit protection.
4. The controller shall have a minimum 5.7” TFT touch screen. Systems that rely on microprocessors and or alphanumeric displays shall not be considered.
5. Operator Interface – 5.7” Minimum TFT touch screen with the following features as a minimum:
 - a. LOCAL / REMOTE start/stop mode select:
 - 1) LOCAL start/stop mode: System shall run based on operator input from touch panel start/stop push-button.
 - 2) REMOTE start/stop mode: System shall start and stop according to the state of remote dry contacts (closed = run, open = stopped).
 - b. MANUAL / PROPORTIONAL AUTO operational mode select.
 - 1) MANUAL mode: The desired water flow is set manually using increase/decrease push-buttons on touch panel. The desired polymer flow is set manually using increase/decrease push-buttons on touch panel. Solution concentration defined by water and polymer settings.
 - 2) MANUAL mode run screen features:
 - a) Water control increase/decrease push-buttons.
 - b) Water flow rate (GPH) display.

- c) Polymer control increase/decrease push-buttons
- d) Polymer flow rate (GPH) display.
- e) Solution concentration (% poly) display.
- f) Total solution flow rate (GPH)
- c. Flow Paced Mode:
 - 1) Water flow adjusts automatically to maintain operator desired solution concentration.
 - 2) Polymer flow paced by remote 4-20mA (supplied by others).
 - 3) Desired solution concentration adjusted manually using increase/decrease push-buttons on touch panel.
 - 4) PACED POLY RATIO mode run screen features:
 - a) Water flow rate (GPH) display.
 - b) Remote pacing signal level (mA)
 - c) Polymer flow rate (GPH) display.
 - d) Solution concentration control increase/decrease push-buttons.
 - e) Desired solution concentration (% poly) display.
 - f) Solution concentration (% poly) display.
 - 5) Help Screens:
 - a) For each mode of operation
 - 6) Alarm screen features:
 - a) Indication of alarm
 - b) Description of recommended corrective action
 - c) Reset
 - d) Alarm history
 - e) Set-up screen features:
 - f) Semi-auto pump calibration
 - g) System flush settings
 - h) Auxiliary alarm user programming mode
 - 7) Discrete Selector Switch & System Indicator:
 - a) Main Power ON /OFF Switch
 - b) Main Power ON indicator
 - 8) Inputs (signals by others):
 - a) Remote Start / Stop (discrete dry contact)
 - b) Pacing Signal Based on Process Flow (4-20mA)
 - 9) Outputs:
 - a) System Running (discrete dry contact)
 - b) Remote Mode (discrete dry contact)
 - c) Common Alarm (discrete dry contact)
 - d) Polymer Pump Rate (4-20mA)
 - 10) Communication: Ethernet/IP

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

- B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Piping:
 - 1. Provide flexible connectors in piping connections to vibrating equipment.
 - 2. Harness or anchor flexible connectors as necessary.
- C. Clean field welds to remove slag and splatter to provide a smooth surface.
 - 1. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment, as indicated on Drawings.
 - 2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
 - 3. Supports:
 - a. Construct piping supports of 304 stainless steel members.
 - b. Brace and fasten with flanges bolted to equipment structure.
- D. Provide rigid anchors for pipes after vibration isolation components have been installed.
- E. Install insulation as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Field Testing:
 - 1. Test for proper alignment.
 - 2. Demonstrate operation without undue noise, vibration, or overheating.
 - 3. Engineer will witness field testing.
- C. Control System: Energize system equipment and test operation of hardware and process control logic under supervision of manufacturer's representative and in presence of Engineer.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one (1) trip two (2) eight (8)

hour days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 33 33

SECTION 46 43 23 – ENERGY DISSIPATING FEED WELLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section retrofit of existing clarifiers with Energy Dissipating Feed Wells.

1.2 REFERENCE STANDARDS

- A. ASTM International:
ASTM A36 - Standard Specification for Carbon Structural Steel.

1.3 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's Product Data for system materials and component equipment, including electrical characteristics.
- C. Shop Drawings:
 - 1. Indicate system materials and component equipment.
- D. Manufacturer's Certificate: Certify that product meets or exceeds specified requirements.
 - 1. Certify that installation is completed according to manufacturer's instructions.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Manufacturer Reports: Indicate that equipment has been installed according to manufacturer's instructions.
- G. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for closeout procedures.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance materials.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on-Site and inspect for damage.
- C. Store materials according to manufacturer's instructions.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 017000 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for energy dissipating feed well equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer
 - 1. Evoqua
 - 2. WesTech
 - 3. Approved Equal

2.2 Design

- A. The Feed Well shall consist of a series of baffle panels and feed skirt to be attached to existing to existing clarifier inlet and provide both flocculating and energy dissipating functions.
- B. A method of attachment shall be provided such that the entire assembly forms a rigid structure capable of supporting its own weight plus snow and wind loads in the event the tank is out of service. The baffle shall also be designed to withstand hydraulic and torsion forces.

2.3 MATERIALS

- A. ASTM A36 Steel.
- B. Minimum thickness: 3/16 inch

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Energy Dissipating Feed well equipment in existing clarifiers after removing existing feed well equipment according to manufacturer's instructions.
- B. Repair any damage to existing clarifier supports or mechanism resulting from installation.

3.2 FIELD QUALITY CONTROL

- A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Dry Startup: Run equipment without liquid in basins and inspect for alignment of feed well or interference with Clarifier operating mechanism.
- C. Wet Startup: Run equipment with wastewater in basins and verify proper operation.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 2 days on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified, and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- F. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.3 ADJUSTING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for starting and adjusting.

3.4 DEMONSTRATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 43 23

SECTION 46 43 81 – FIBERGLASS REINFORCED PLASTIC DENSITY BAFFLE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes fiberglass reinforced plastic (FRP) density current baffles for clarifiers.

1.2 QUALITY ASSURANCE

- A. Manufacturer shall be a reputable qualified manufacturer of FRP products.
- B. The manufacturer shall provide documentation of five (5) installations of comparable size and that have been in operation for at least three (3) years.

1.3 SUBMITTALS

- A. The following shall be submitted in accordance with the General and Special Provisions.
 - 1. Shop Drawings
 - a. Dimensions
 - b. Job Specific Layout
 - c. Sectional Assembly
 - d. Location and identification markings
 - e. Accessories, attachments, transition pieces
 - f. Connection Details
 - 2. Manufacturer's catalog data showing:
 - a. Dimensions, spacing, and construction details
 - b. Materials of construction
 - c. Description
 - d. Five (5) installations of comparable size
 - 3. Certificates
 - a. Submit Manufacturer's certification that all materials furnished are in compliance with the applicable requirements of this specification
 - 4. Manufacturer's Instructions
 - a. Submit complete information and instructions relating to storage, handling, installation, and inspection of all equipment related to this section.

1.4 STORAGE AND TRANSPORTATION

- A. All FRP components shall be shop fabricated and assembled as much as possible
- B. The parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
- C. All FRP materials shall be stored until installation in a manner that prevents cracking, chipping, or damage to the materials.

1.5 COORDINATION

- A. Clarifier sludge evacuation shall be performed at the convenience of the OWNER. The CONTRACTOR shall schedule outages with the OWNER.

1.6 WARRANTY

- A. Manufacturer shall warrant the Density Current Baffle to be free of defects in materials and workmanship for a period of five (5) years after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer
 - 1. Enduro
 - 2. NEFCO
 - 3. WESTECH
 - 4. Approved Equal

2.2 Design

- A. The Stamford Density Current Baffle shall consist of a series of baffle panels that are attached to the wall of the clarifier to form an inclined, shelf-like surface around the entire inner periphery of the tank. Each panel shall be molded of corrosion-resistant, UV-treated fiberglass. The panel shall be a maximum of 8 feet in length and shall be curved to follow the curvature of the clarifier tank. The width, inclination angle and mounting location of the baffle shall be determined based upon the clarifier configuration in order to provide optimum baffle performance. The panels shall be designed such that adjacent panels fit together without overlapping or cutting, and the completed baffle when installed, has a well-engineered and professional appearance.
- B. The inclination angle of the baffle shall be 30 degrees as measured from the horizontal and the horizontal projection of the baffle shall be defined by the following equation:

- C. Horizontal Projection (Inches) = 24 inches + 0.4in/ft x (tank diameter (ft) - 30)
- D. Suppliers offering alternate configurations must provide CFD modeling results showing that the proposed alternate equals the performance of the specified configuration.
- E. Provision shall be made to attach the panels to the clarifier wall and support them at the proper angle using a triangular panel bracket. The panel and bracket shall be molded as an integral part of each panel, forming a baffle module, or separate panels and brackets may be supplied. If the panel and bracket are molded as an integral unit with adequate stiffeners, only one bracket is required per panel. A specially formed "free-end" bracket shall be provided to support the free end of the last panel where the run of panels is interrupted by an obstruction. Panels may be cut as required to fit around obstructions.
- F. If separate panels and brackets are supplied, the panels shall be molded of fiberglass and shall meet the specifications of this section. The brackets shall be fabricated of 3" x 3" x 1/4" stainless steel angle and shall be triangular in shape, with the corners welded. Brackets shall be installed at a maximum spacing of four (4) feet. The panels shall be fastened to the brackets with stainless steel nuts, bolts and lock washers every 8 inches.
- G. In the case of clarifiers/settling tanks with inboard launders, two scenarios are possible:
 - 1. If there is sufficient vertical clearance between the top of the blanket and the bottom of the launder to position the bottom of the baffle at least two feet above the top of blanket, then the baffle shall be mounted directly to the tank wall at or above that position.
 - 2. Where the clearance is more restricted, the baffle shall be mounted to the lower inboard corner of the launder trough. In this case, the width of the trough shall be taken into account when calculating the horizontal projection of the baffle, and the horizontal projection shall not be less than 24".
- H. A method of interconnecting adjacent panels shall be provided such that the entire assembly forms a rigid structure capable of supporting its own weight plus snow and wind loads in the event the tank is out of service. The baffle shall also be designed to withstand a buoyant force load equal to the weight of the water displace from the volume beneath the baffle. The angled working surface of each baffle shall be sufficient in pitch and width to divert the flow and to create a self-cleaning action of the baffle itself.
- I. Provision shall also be made to vent gases that may form beneath the baffle through 3" diameter half-round openings molded into the panel at its highest point. The vents should aim radially towards the center of the tank, such that any bubbling and/or by-passing current is directed away from the weir, preventing short-circuiting. Specially in cases where the panels are to be launder-mounted, with the vents sitting directly below the weir and scum baffle.

2.3 MATERIALS

- A. Each baffle panel shall be molded of fiberglass-reinforced plastic. The resins and fiberglass reinforcing material shall be consistent with the environmental conditions and structural requirements.

- B. The resin shall be an isophthalic polyester resin with corrosion-resistant properties, Corezyn COR75-AQ-010 or equivalent, suitable for use in submerged waste treatment applications. The resin shall not contain fillers except as required for viscosity control. For viscosity control, a thixotropic agent up to 5% by weight may be added to the resin. The resin shall be treated to provide UV suppression.
- C. Glass reinforcement shall consist of chemically bonded surfacing mat and chopped strand roving. Surfacing mat shall be Type C veil. The glass reinforcement shall be 357-211 PLN CTC chopped strand roving or equivalent. The glass content of the finished laminate shall not be less than 30% by weight. The nominal thickness of each baffle panel shall be 1/4" (+/-) 1/16-inch-thick with resin rich surfaces and edges to prevent migration of moisture and fiber "blooming." The baffle shall be black in color.
- D. The upper surface of each panel shall be mold smooth and no glass fibers shall be exposed. Laminations shall be dense and free of voids, dry spots, cracks or crazes. The upper surface of the baffle shall be reinforced with one layer of surfacing veil followed by 2 ounces or more of chopped strand roving. In addition, the vertical mounting flange (return flange on launder mount applications) shall be reinforced with one layer of 24 oz woven roving.
- E. No other glass product is permitted between these layers. All factory-trimmed edges shall be "hot coated" with resin to prevent wicking.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The installation contractor shall field verify existing dimensions and install the baffle in accordance with the contract drawings, approved shop drawings and manufacturer's recommendations. Mounting holes shall be factory drilled. Field cutting of baffle panels will be allowed to complete the structure and accommodate in-tank obstructions. All field cut or drilled edges shall be coated per the manufacturer's recommendations to prevent fiber blooming or fraying.
- B. All of the fasteners required for installation shall be supplied by the baffle manufacturer. The baffle panels shall be attached to the wall using 3/8" x 3-3/4" concrete expansion anchors with oversized 1/8" x 2-1/4" stainless steel washers, and hex nuts. Adjacent baffle panels are fastened together using 1/4" bolts, 2 flat washers, lock washer, and hex nut. All of the installation fasteners shall be stainless steel.
- C. The density current baffle shall extend completely around the tank and shall be level, rigid and free of sway that could work anchors loose or cause undue wear.

END OF SECTION 46 43 81

SECTION 46 61 23 - DISC CLOTH TERTIARY FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Disc cloth filters

B. Related Requirements:

1. Section 26 05 33.02 - Equipment Wiring Connections: Execution requirements for electrical connections to equipment specified by this Section.
2. Section 26 29 23 - Variable-Frequency Motor Controllers: Drive unit for filter shaft.

1.2 DEFINITIONS

A. ABS: Acrylonitrile butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

1.3 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 COORDINATION

A. Coordinate Work of this Section with Work of other Sections.

1.5 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.

1.6 SUBMITTALS

A. Manufacturer shall provide, at a minimum, the following information in accordance with Section 01 33 00 Submittals.

1. Product Data/Information
2. Calculations verifying the effective filtration surface area.
3. Hydraulic profile through the filter showing influent and effluent weir lengths, elevations, and nappe at design and peak flow.

4. Shop Drawings
5. Maintenance Instructions
6. Installation Instructions
7. Wiring Diagrams
8. Parts List
9. Qualification Data
10. Sample Warranty

- B. Manufacturer shall provide Operations and Maintenance Data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
1. (2) Frame and cloth assemblies.
 2. (1) Backwash/solids waste valve and actuator.
 3. (1) Viton V-ring effluent port/centertube seal
 4. At least 1 of each fuse(s), control relay(s), and indicating light replacement bulb(s)
- A. Tools: Furnish special tools and other devices required for Owner to maintain equipment.

1.8 QUALITY ASSURANCE

- A. The Contractor shall assign full responsibility for the functional operation of all components of the cloth media filtration to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing Contractor's equipment installation and connections, calibrate, and place into operation the aforementioned systems along with all other equipment and accessories as specified herein.
- B. The Manufacturer shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store and protect materials according to manufacturer instructions.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.
- C. The Contractor shall furnish a warranty extending twelve (12) months after substantial completion date of the project in its entirety.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. Aqua-Aerobic – Model ADFSC-108x16E-PC
- 2. Approved Alternate - Specifications and equipment arrangements for the Disc Cloth Filters are based on Aqua-Aerobic. Changes to the arrangement indicated in the specifications and in the plan set shall be at the expense of the installing contractor. No change orders will be issued to the contractor for modifications to the laying length, footprint, concrete layout, electrical, mechanical, etc. Filter area is not considered a CID2 Area.

2.2 SCHEDULE

- A. DF-5100
- B. DF-5200

2.3 GENERAL

- A. Each filtration unit shall include:
 - 1. Basin Mounting Brackets and Hardware.
 - 2. Drive Assembly
 - 3. Centertube Assembly with Cloth Media Discs
 - 4. Backwash System
 - 5. Backwash/Waste Pump Assembly
 - 6. Valves
 - 7. Influent Weir
 - 8. Effluent Weir
 - 9. Scum Trough and Weir
 - 10. Pressure Transducer Assembly- KPSI Model 710

11. Float Switch- Vendor Provided
 12. Vacuum Transmitter- IFM Effector PA Series
 13. Electrical Controls with Internal Components
- B. Design Criteria
1. Upstream Biological Process: PurOx
 2. Secondary Clarifier Effluent Parameters
 - a. TSS: 15 mg/L average and 20 mg/L maximum
 3. Flow: 13.5 MGD maximum monthly, 27 MGD peak hourly
 4. Filter effluent suspended solids: less than or equal to 5 mg/l
 5. Filtration system shall be designed to treat 100% maximum monthly flow to meet the effluent limitations with one unit out of service.
- C. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.
- D. Filter Disk Basin
1. Each filter shall be installed in a concrete basin.
- E. Basin Mounting Brackets and Hardware
1. Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with 304 stainless steel wedge anchors and hardware.
 2. Through the wall spool piping and all external filter piping shall be provided by the Installing Contractor.
- F. Drive Assembly
1. Each filter shall include an adjustable drive assembly with a gearbox, cast iron hub with 316 stainless steel sprocket segments, 15-5 PH stainless steel drive chain with 17-4 PH stainless steel link pins, and a 304 stainless steel chain guard.
 2. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 5 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.
 3. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.
 4. If motors and gearboxes require routine maintenance, and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.
- G. Centertube Assembly
1. Each centertube assembly shall include a minimum 1/4" thick 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials

other than Viton are not acceptable for seal materials. Systems with swivel joints requiring routine lubrication are not acceptable. The driven sprocket shall be multi segment made of nylon 6. All fasteners shall be stainless steel.

2. Cloths shall be of fiber pile construction having a nominal filtration rating of 5 microns. Granular media and screens having structured identical openings shall not be allowed. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or micro screen type media with no filtration depth are not acceptable. To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.
3. Each cloth disk assembly shall be comprised of eight (8) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene copolymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.
4. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.
5. Each cloth disk assembly shall have a minimum of 107.6 square feet of effective submerged filtration area. Effective submerged filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into no more than eight (8) segments and shall be easily removable for service.
6. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths from the inside to the outside of the cloth frame that collect filtered solids and plastic debris on the interior surfaces of the cloth frame will not be acceptable.
7. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

H. Backwash and Solids Removal System

1. Each filter shall include a solids waste removal system consisting of perforated manifold, mounted on the floor of the filter basin. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.
2. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.
3. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two (2)

backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface.

4. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.
5. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
6. The backwash system shall include 304 stainless steel backwash shoe supports with UHMW backwash shoes, 316 stainless steel springs, reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifolds, and PVC sludge collection manifold.
7. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

I. Backwash/Waste Pump Assemblies

1. Each backwash/waste pump assembly shall include one (1) backwash/waste pumps (P5100, P5200), valves and gauges. In the external piping shall be backwash and solids waste valves, two 6" recirculation plug valves for each pump (V5100,V5101,V5200,V5201), vacuum gauge(s) (VI5111, VI5211), vacuum transducer(s) (VIT5111, VIT5211), and pressure gauge(s) (PI5111, PI5211).
2. The backwash/waste pumps (P5100, P5200) shall be a Gorman Rupp externally mounted centrifugal pump. Pump shall be provided with a 20 HP, 460-volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 782 gpm at 58.3 ft TDH with 34.3 ft allowable discharge head after losses in internal filter piping have been accounted for. Motor shall be Baldor, Teco, Weg or approved equal. Each pump shall be provided with a painted 304 stainless steel support stand with wedge anchors.
3. Backwashing shall be initiated by basin water level, timer, or manually through the operator interface. Operator shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted.
4. One flow meter shall be provided per filter (FE5100, FE5200). Flow meter shall be 6" Krohne Enviromag 2100 C series with IFC100 C signal converter integral to flow meter. Output shall be 4-20 mA. The flow meter shall be provided loose to be installed and wired by the installing contractor.
5. The 6 inch flanged plug valves (V5100,V5101,V5200,V5201) shall be Milliken 601, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size
6. The vacuum gauge(s) (VI5111, VI5211) shall have a minimum 2.5" dial with all stainless-steel welded construction, 0-30" Hg vacuum range, liquid filled, 1/4" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.
7. The pressure gauge(s) (PI5111, PI5211) shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, 1/4" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.

J. Valves

1. Each filter shall include two (2) 6" backwash valve(s) (V5105, V5106, V5205, V5206). Valve(s) shall be Milliken 601, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated non-lubricated ductile iron plug with 80 % port opening, assembled and tested with an Auma 115-volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light (s)
2. Because of fouling that can be caused by stringy material, non-full port valves such as butterfly valves or plastic valves shall not be acceptable.
3. Each filter shall include one (1) 6" solids waste valve (V5104, V5204). Valve(s) shall be Milliken 601, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated non-lubricated ductile iron plug with 80 % port opening, assembled and tested with an Auma 115-volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s).
4. Each filter shall include a solids waste removal system consisting of perforated manifold. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

K. Pressure Transducer

1. A submersible pressure transducer (PE5110, PE5210) shall be supplied for each filter basin. The pressure transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 to 5 psi. Units shall monitor the water level in the filter basin. Pressure transducer shall be provided with a mounting bracket and 316 stainless steel anchors. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. An aneroid bellows providing vented gage atmospheric reference shall be supplied for Contractor installation in junction box. The installing contractor shall provide junction box, bellows mounting and interconnecting wiring. Transducers shall be KPSI Model 710 series or approved equal.

L. Scum Weir and Scum Removal System

1. A 304 stainless steel scum weir shall be provided by the filter manufacturer for each filter basin. A scum removal valve shall also be provided for the filtration system. Each filter basin shall have a scum removal valve. The scum valve (V5102, V5202) shall be 8" Milliken 601, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated non-lubricated ductile iron plug with 80 % port opening, assembled and tested with an Auma 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater, manual override, and limit switch feedback in the open and closed position. Actuator(s) include local controls consisting of pushbutton(s), selector switch(es), and light(s).

M. Vacuum Transmitter – IFM Effector PA Series (vendor provided)

N. Level Switches – Conform to requirements in Section 40 72 76 – Level Switches

O. Control Panel:

- a. Free-Standing 304 stainless steel enclosure.
 - b. NEMA 250 Type 4X.
 - c. Furnish single-point power connection and grounding lug.
 - d. Control Power Transformer (minimum 5kva).
 - e. 15A 120v service receptacle.
 - f. Power supply for wireless transmitter.
 - g. Provided by Filter Manufacturer
2. Controls: PLC based, Allen Bradley Compact Logix Controller.
3. Operation Sequences:
 - a. Backwash initiated by level probe as head increases.
4. Communications
 - a. The panel shall include a Hirschmann Model Gecko 4TX Managed Ethernet Switch and Hirschmann Model OZD 485 G12 BAS 943893321 Fiber Interface to provide connectivity to the plant-wide SCADA System furnished under other sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Install according to manufacturer instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than three (3) trips totaling six (6) days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.
- C. Equipment Acceptance:
 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 2. Make final adjustments to equipment under direction of manufacturer's representative.

- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 46 61 23

APPENDIX A-
SCADA ALLOWANCE SCOPE OF SUPPLY

Goodwyn Mills and Cawood
Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007
March 31, 2020

Proposal No. EM190346, Rev. 1

Scope



Scope of Supply

**Goodwyn Mills and Cawood
1450 Greene Street
Suite 505
Augusta, GA 30901**

**Attention:
Mitch Freeman, Senior Project Manager, Engineering**

**Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007**

March 31, 2020

**Proposal No. EM190346, Rev. 1
Prepared by: Brian Thomason**

Proposal No. EM190346, Rev. 1

Scope

1.0 Introduction

Electric Machine Control will supply the SCADA Control Equipment and Integration for the Brunswick – Academy Creek 2019 WPCF Rehabilitation Project based on the plans and specifications provided by Goodwyn Mills and Cawood dated March 12, 2020. This proposal is also based on our past experience with BGJWSC and GMC and multiple discussions and emails pertaining to this project.

The following 100% Submittal Drawings were submitted for our review:

- I-001 Process & instrumentation Diagram – Legend
- I-004 P&ID – Block Diagram
- I-101 P&ID – Screening
- I-102 P&ID – Grit Removal
- I-103 P&ID – Influent Pump Station
- I-201 P&ID – Pre-Aeration & Flow Split
- I-301 P&ID – Aeration Basins 1, 2 & 3
- I-401 Process & Instrumentation Diagram – Clarifiers 1 & 2 - RAS
- I-402 Process & Instrumentation Diagram – Clarifiers 3 & 4 - RAS
- I-403 Process & Instrumentation Diagram – Clarifiers 5 & 6 - RAS
- I-501 Process & Instrumentation Diagram – Tertiary Filters
- I-601 P&ID – Chlorine Contact Chambers
- I-701 Process & Instrumentation Diagram – Sludge Pumping
- I-702 Process & Instrumentation Diagram – Belt Filter Presses
- I-703 Process & Instrumentation Diagram – Sludge Unloading
- I-801 Process & Instrumentation Diagram – Chemical Feed Systems
- I-802 Process & Instrumentation Diagram – BFP Polymer Feed
- I-902 Process & Instrumentation Diagram – Instrument Schedule

The following specification sections were submitted for our review:

- 40 71 13 – Magnetic Flow Meters
- 40 72 24 – Radar Level
- 40 72 76 – Level Switches



Proposal No. EM190346, Rev. 1

Scope

- 40 72 78 – Optical Rotary Shaft Encoders
- 40 73 13 – Pressure and Differential Pressure Gauges – *(See Note Below)*
- 40 73 26 – Gauge-Pressure Transmitters – *(See Note Below)*
- 40 73 63 – Diaphragm Seals – *(See Note Below)*
- 40 73 64 – Annular Pressure Seals – *(See Note Below)*

Note: Although each of these spec sections were provided for our review not all of them included equipment related to EMCs scope of supply.

2.0 Proposed Scope of Supply

Electric Machine Control will supply the SCADA Control Equipment and Integration for the Brunswick – Academy Creek 2019 WPCF Rehabilitation Project per the plans and specifications provided.

This proposal includes PLC Panels, SCADA Engineering, HMI/Graphics Engineering and Design, PLC Programming, Drawings/Documentation, Start-up, and Training required for the WPCF improvements. For the purposes of this 100% Design Proposal it is assumed the existing SCADA Equipment/Hardware and SCADA Software package will be reused.

Electric Machine Control will provide the panels as listed in the schedule below with associated PLCs and required programming. EMC will also provide the Field Instruments as listed below. Both the Panels and Field Instruments will be added to the Customer's existing VTScada system. EMC will provide all associated screens to depict the new equipment. EMC will also provide start-up, training, drawings and documentation of the equipment described.

This proposal is based on our interpretation of the drawings available at the date of this proposal. Where specific information was not provided or available certain assumptions were made based on our discussions and past experiences with BGCJWSC and GMC in order to develop this proposal.

This proposal is for the 100% Design Complete phase of the project.



2.1 Equipment

Electric Machine Control will provide the following equipment to be installed by others at the Brunswick – Academy Creek WPCF.

2.1.1 Panels Schedule

Based on the drawings provided there will be a total of seven (7) panels. The following PLC, I/O Panels, and Local Control Stations will be provided. All panel enclosures are 304 SS.

Title
LCP1000
LCP4010
LCP4020
LCP7000
LCP0100
LCP0200
LCP0110

Note: Panels listed above will include the basic control items as specified for their location. Those items may include some or all of the following:

- NEMA 4X Enclosures
- Fans
- Thermostat
- Circuit Breakers
- AC Surge Protection
- GFI Receptacle
- Fiber Optic Termination and Jumper
- Power Supply
- A-B Stratix Managed Ethernet Switch
- A-B CompactLogix PLC with associated Power Supply and I/O Modules
- Communication Hardware as needed
- DC Surge Protection
- Relays
- Fuses
- Terminal Blocks



- Ground Terminal Blocks
- Ground Bar
- Wire Labels
- Duct
- Misc. Electrical Components.

Note: Panel LCP0100 includes no PLC.

2.1.2 Network Equipment and Software

SCADA Hardware and Software is existing at the Academy Creek WPCF. The following new Network SCADA Hardware and Software will be provided in this project.

Description	Qty.
Managed Ethernet Switch	1
Fiber Optic Patch Panel	1
Programming PC	1
Rockwell PLC and HMI Software Suite	1
UPS	1
Remote Control Software	1

2.1.3 Field Equipment

Only the following Field Equipment will be provided per the plans and specifications (I-902 Instrument Schedule is the basis):

Manufacturer	Description	Qty.
Rosemount	16" Mag-Meter	4
Asco	Surge Protection in NEMA 4X Enclosure	4
	Sunshield	4
Rosemount	Radar Level Transmitter	1
Rosemount	Remote Signal Indicator	
Asco	Surge Protection in NEMA 4X Enclosure	1
	Sunshield	1
Dynapar	Optical Rotary Shaft Encoder, NEMA 4X, 4-20mA	3



Badger	DFX Digital Doppler Flow Meter	1
Asco	Surge Protection in NEMA 4X Enclosure	1
	Sunshield	1

Note: Manufacturers listed are provided for reference only and could be changed as needed to another approved equipment supplier.

2.2 Engineering Services

Brunswick – Academy Creek WPCF Engineering will include the following Engineering Services:

- Project Design Engineering
- PLC Programming
- SCADA Programming
- HMI Graphics
- Network Configuration
- Panel Layout / Design
- Panel Fabrication
- Drawings
- Documentation
- Panel Testing
- SCADA System Testing
- Start-up
- Training

2.3 General Notes

General Project Notes subject to modification once design is completed.

- Electrical Testing will be provided per the plans and specifications.
- Training – is included per the plans and specifications.

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- Spares – Electrical Spares per the plans and specifications.
- Drawings / Documentation – Drawings and Documentation are included per the plans and specifications.
- Start-up and Commissioning – Start-up and Commissioning is included per the plans and specifications.
- Schedule To be determined.
- Payment Terms – Schedule of Values will be provided at time of order. All progress payments will be Net 30 Days.
- Freight F.O.B. Delivered to Job Site

2.4 Exceptions / Notes:

- Hangers and brackets to be provided by others.
- Installation of equipment specified above is by others.
- Panel mounting by others.
- Wiring and wire terminations by others.
- Fiber terminations by others.

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ELECTRIC MACHINE CONTROL, INC.
TERMS AND CONDITIONS OF SALE

A. Acceptance

This quotation, together with any other documents incorporated herein or attached hereto, constitutes an offer to supply Buyer the goods to be purchased (or, in the case of software (including embedded microcode, subroutines and other computer code whether provided solely in object or in object code and source code), licensed) pursuant to this quotation. This quotation supersedes any prior oral or written communications between Seller and Buyer. BY ACCEPTING THE GOODS, OR ORDERING THE GOODS, BUYER AGREES TO AND ACCEPTS THE TERMS AND CONDITIONS APPLYING TO THE SALE OF THE GOODS PURCHASED PURSUANT TO THIS QUOTATION. BUYER'S ACCEPTANCE OF THIS OFFER IS EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS CONTAINED HEREIN. ANY ADDITIONAL OR DIFFERENT TERMS OR CONDITIONS, INCLUDING THOSE CONTAINED IN BUYER'S PURCHASE ORDER OR ACCEPTANCE OF THIS OFFER, ARE HEREBY OBJECTED TO. These terms and conditions shall also govern any services rendered to Buyer. If any terms or conditions in the purchase order or acceptance of this offer are in conflict or not identical to the terms of this offer, the terms and conditions of this offer shall prevail. This offer may be withdrawn or modified by Seller at any time prior to Buyer's acceptance of the terms and conditions contained herein, and unless otherwise stated will expire automatically 30 days from the date hereof unless so accepted by Buyer. Acceptance is effective only upon receipt of acceptance by Seller.

B. Prices – Prices are:

1. Subject to change without notice prior to acceptance of Buyer's order by Seller.
2. Exclusive of all Federal, State, Municipal or other Government Excise, Sales, Use, Occupational or like taxes now in force or to be enacted in the future.
3. Subject to an increase equal in amount to any tax the Seller may be required to collect or pay upon the sale of the items quoted.
4. Quoted F.O.B. place of manufacture.

C. Terms

1. The terms of payment for goods are as follows unless otherwise specified.
 - a. Net cash within thirty (30) days from the date of invoice unless otherwise specified by Seller to Buyer with approved credit. Buyer to supply satisfactory credit references.
 - b. Any progress payment terms offered will be net 30 days.
2. Interest may be charged at the rate of 1 ½ % per month or the maximum rate allowed under state law if it is a lesser number, on any payments which are not received by the due date. Any expenses of collection, including reasonable attorney's fees, shall be borne by Buyer.
3. Seller reserves the right to modify these terms for export business and special projects.

D. Shipping Estimates

1. The shipping date shown in this quotation is approximate and dependent upon prior sales and circumstances beyond Seller's control.
2. Shipping date will be computed from the date of receipt of all data required to enable complete engineering or acceptance of Buyer's order as provided in the Acceptance paragraph above, whichever is later.
3. Every effort will be made to effect shipment within the time stated, but Seller will not be liable for any damages resulting directly or indirectly from fire, embargo, strikes, or acts of God, civil strife or insurrection, transportation delay, whether at place of manufacture or elsewhere, or from delay by reason of any rule, regulation or order of any government authority directly affecting delivery, or from other causes beyond Seller's control. In the event of such a delay, the shipping date shall be extended for a reasonable length of time at least equal to the period of such delay.
4. Any change in Buyer's requirements will require confirmation or revision of estimated shipping date.
5. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, SPECIAL, DIRECT, OR CONSEQUENTIAL DAMAGES OCCASIONED BY DELAYS, WHETHER OR NOT SUCH DELAYS ARE BEYOND SELLER'S CONTROL.

E. Delivery

Unless otherwise specified on this quotation, all goods shall be shipped F.O.B. Seller's place of manufacture, at which point title and risk of loss to the goods shall shift to Buyer. Seller undertakes only to deliver the goods to the carrier, to make a reasonable contract of carriage for their transportation, to obtain and deliver or tender such documents as may be necessary to enable Buyer to obtain possession, and to promptly notify Buyer of the shipment. Specifications or arrangements relating to the shipment of the goods covered by this agreement are at Seller's option.

F. Installation

1. When deemed necessary by Seller, or when required by Buyer's purchase order and included in Seller's price quotation, Seller or its agent will supply a service representative to provide technical direction for setting up and demonstrating the operation of the goods.
2. All cost incident to the erection and installation shall be borne by the Buyer. Additional or special services will be quoted on request.

H. Warranty

ELECTRIC MACHINE CONTROL, INC.
7015 Haisten Drive
Trussville, AL 35173

(205) 661-3998
(800) 362-9545
www.emcinc.biz

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Brunswick Glynn County Joint Water and Sewer Commission
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1. Any goods or parts thereof covered by this quotation which under normal operating conditions in the plant of the original user thereof, proves defective in material or workmanship within 12 months from start-up of equipment or 18 months from date of shipment by Seller which ever comes first as determined by an inspection by Seller, will be repaired or replaced at our discretion, at our plant free of charge, provided that Buyer promptly sends Seller written notice of the defect and establishes that the goods have been properly installed, maintained and operated within the limits of rated and normal usage. The liability of Seller under this warranty or for any loss or damage to the goods, whether the claim is based on contract or negligence, shall not in any case exceed the purchase price of the goods, and upon the expiration of the warranty period, all such liability shall terminate. This warranty, as it relates to electronic control units, only applies if the user has in his employ qualified maintenance personnel.

With regard to software, Seller warrants that such software will comply with the specifications, if any, published by the Seller with respect to the software. Buyer, as licensee, acknowledges and agrees that the software will not run uninterrupted or problem free. In the event the software proves defective within one year from the date of shipment by Seller, Seller will, if commercially practicable, repair such software to conform to specifications or provide replacement software.

2. The terms of this warranty do not in any way extend to any goods purchased or manufactured (with respect to this quotation) which have a separate warranty or life under normal usage inherently shorter than the one year period indicated above. Subject to the terms and conditions set forth herein, the warranty on any purchased goods is expressly limited to those offered by their respective manufacturer and which Seller may pass through to Buyer.
3. This warranty shall be void and Seller shall not be liable for any breach of warranty if the goods or parts thereof covered by this quotation shall have been repaired or altered by persons other than Seller, unless expressly authorized by Seller in writing.
4. THE FOREGOING WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED BY SELLER AND ARE EXCLUDED FROM THIS AGREEMENT. SELLER SHALL NOT BE LIABLE FOR ANY INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY BREACH OF WARRANTY.

I. Limitation of Liability

1. BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY SHALL (AT SELLER'S SOLE DISCRETION) BE THE REPAIR OR REPLACEMENT OF DEFECTIVE GOODS, AND SUCH REMEDY IS EXPRESSLY IN SUBSTITUTION OF ANY AND ALL REMEDIES OTHERWISE PROVIDED UNDER THE UNIFORM COMMERCIAL CODE OR OTHER STATE OR FEDERAL LAW. Provided, however, if the goods are incapable of being repaired or replaced, Buyer's exclusive remedy shall be money damages, but such damages shall not exceed the purchase price of goods.
2. Any claim for breach of Seller's warranty must be in writing addressed to Seller, must set forth the alleged defect in sufficient detail to permit its easy identification by Seller and must be made no later than 10 days after the discovery of the breach. Any breach of warranty claim not made within one year of shipment of goods by Seller will not be honored by Seller and will be of no force and effect.
3. Seller's liability on any claim of any kind, including negligence for any loss or damage arising out of, connected with or resulting from this quotation, or from the performance or breach thereof, or from the design, manufacture, sale, services rendered, delivery, resale, installation, technical direction of installation, inspection, repair, operation or use of any goods covered by or furnished under this quotation shall in no case (except as provided in the paragraph entitled Property and Patent Rights), exceed the purchase price allocable to the goods and shall terminate on year after the goods have been shipped.
4. IN NO EVENT SHALL SELLER, NOR ITS AFFILIATED BUSINESSES, NOR THE OFFICERS, DIRECTORS, AGENTS AND EMPLOYEES OF THE FOREGOING, BE LIABLE TO BUYER, (NOR TO ANY THIRD PARTY) IN ANY ACTION OR CLAIM FOR DIRECT, CONSEQUENTIAL, SPECIAL AND/OR INCIDENTAL DAMAGES, LOSS OF PROFITS, LOSS OF OPPORTUNITY, LOSS OF PRODUCT OR LOSS OF USE, WHETHER THE ACTION IN WHICH RECOVERY OF DAMAGES IS SOUGHT IS BASED ON CONTRACT, TORT (INCLUDING PRODUCT LIABILITY, SOLE, CONCURRENT OR OTHER NEGLIGENCE AND STRICT LIABILITY), STATUTE OR OTHERWISE. TO THE EXTENT PERMITTED BY LAW, ANY STATUTORY REMEDIES WHICH ARE INCONSISTENT WITH THESE TERMS ARE WAIVED. IN THE EVENT THAT ANY OTHER TERM OF THIS AGREEMENT IS FOUND UNCONSCIONABLE OR UNENFORCEABLE FOR ANY REASON, OR ANY EXCLUSIVE REMEDY FAILS OF ITS ESSENTIAL PURPOSE, THIS PROVISION OF WAIVER BY AGREEMENT OF DIRECT, CONSEQUENTIAL, SPECIAL AND/OR INCIDENTAL DAMAGES SHALL CONTINUE IN FULL FORCE AND EFFECT.

J. Property and Patent Rights

1. With regard to software, Seller is granting to Buyer a non-transferable, nonexclusive license to use such software solely on computer systems owned or leased by Buyer, and solely for use by Buyer in Buyer's business. Other than this license, Seller is not granting any right title or interest in the software. Furthermore, Seller retains to itself any and all property rights in and to all designs, inventions and improvements pertaining to any goods designed in connection with the quotation and to all patents, trademarks, copyrights and related property rights arising out of the work done in connection therewith. Buyer expressly agrees that it will not assert any rights to property rights retained herein by Seller.
2. As to any goods, or parts thereof, manufactured to Buyer's design specifications, Seller assumes no liability whatsoever for patent infringement and Buyer shall indemnify and hold Seller harmless from any liability arising out of the infringement of any patent in the manufacture, sale or use of any goods described in Buyer's specifications.

Buyer agrees to treat as confidential and to safeguard against disclosure to any other person or entity all such software licensed pursuant to these terms and conditions. Buyer acknowledges the Seller possesses intellectual property rights in such software and owns the copyright in and to such software, and further expressly agrees that it will not copy (except for one backup copy that may be maintained by Buyer solely for archival purposes), decompile, disassemble, reverse engineer or attempt to reverse engineer any software licensed pursuant to these terms and conditions nor will Buyer assist others in doing or attempting to do so. To the extent that Buyer makes permitted copies of any software or other intellectual property provided pursuant to these terms and conditions, Buyer will reproduce any and all proprietary notices contained on or in such software or intellectual property.

K. Reservation of Rights in Respect to Seller's Other Products

ELECTRIC MACHINE CONTROL, INC.
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Goodwyn Mills and Cawood
Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007
March 31, 2020

Proposal No. EM190346, Rev. 1

Scope



Seller reserves the right to make improvements and changes in design upon its goods without any obligation to make such changes or improvements upon the goods that are the subject of this quotation or on goods previously manufactured and sold by it.

L. Limitation of Actions

Any statute or law to the contrary notwithstanding, any action to recover for any loss or damage arising out of or connected with, or resulting from this quotation, or from the performance or breach thereof must be commenced within a one year period after the cause of action accrues to Buyer, unless otherwise extended by Seller in writing. It is expressly agreed that there are no warranties of future performance pertaining to the goods that are the subject of this quotation that would extend such one year period of limitation.

M. Cancellation

In the event Buyer requests Seller to stop work or cancel the order or any part thereof, cancellation charges shall be paid to Seller as follows: (i) any and all work that is complete or scheduled for completion within thirty days of the date of notification in writing to stop work or to cancel, shall be invoiced and paid in full and; (ii) for work in process, other than covered by item (i), and any materials and supplies procured, or for which definite commitments have been made by Seller in connection with Buyer's order, the Buyer shall pay the actual costs and overhead expenses determined in accordance with good accounting practices, plus 15% and; (iii) an amount equal to 15% of the difference between the cancellation charge as computed in item (ii) and the full purchase price of the goods will be charged as compensation for business irretrievably lost as a result of accepting a purchase order based on this quotation and having said purchase order canceled by the Buyer and; (iv) Buyer shall promptly instruct Seller as to the disposition of the goods and Seller may, if requested in a writing signed by Buyer, hold the goods for Buyer's account. All costs of storage, insurance, handling, boxing or other costs in connection therewith shall be borne by Buyer.

N. Applicable Law

This quotation and the rights and obligations of the parties, shall be construed pursuant to the laws of the State of Alabama, excluding Alabama's conflict of laws. Buyer and Seller acknowledge that this agreement necessarily involves, and is entered into in furtherance of, interstate commerce. All disputes based on or arising out of this agreement shall be resolved by binding arbitration and governed pursuant to the rules of the American Arbitration Association. In no event shall any arbitrator expand nor restrict any of the party's respective rights nor obligations beyond those as set forth in this agreement.

O. Waiver of Terms and Conditions

Failure or delay of Seller to insist upon strict performance of any of the terms and conditions of this quotation or to exercise any rights or remedies provided herein or by law, shall not release Buyer from any of the obligations of this quotation and shall not be deemed a waiver of any right of Seller to insist upon strict performance hereof or of any rights or remedy of Seller as to any prior or subsequent default hereunder. The headings used herein are for convenience only and shall be given no legal effect.

P. Indemnification by Buyer

Buyer shall indemnify, defend, save and hold Seller, its affiliated businesses (and the directors, officers, employees, agents of the same) and any person acting for or on its behalf, harmless from and against any and all liability, damage, loss, claims, demands, judgments and actions of any nature whatsoever which are claimed to arise out of, result from or connected with (i) engineering specifications, data or criteria furnished by Buyer to Seller (provided Seller manufactures the goods in accordance with such specifications, data or criteria); (ii) changes in criteria made by Buyer; (iii) Buyer's negligence, errors or omissions in Buyer's performance or non-performance of its obligations under this agreement; or (iv) the failure by Buyer, its agents, employees or anyone acting through or on its behalf, to properly operate the goods in accordance with manuals, directions or other operating specifications furnished by Seller to Buyer.

Q. Complete Agreement

Any orders received by Seller in response to this quotation shall not be binding or firm orders until approved by Seller. This quotation, when accepted by Buyer in accordance with the Acceptance paragraph hereof, and/or when Seller's acknowledgment of receipt of acceptance is given to Buyer, shall constitute the entire agreement between the parties relating to this quotation and the goods provided pursuant thereto, shall supersede all previous communications or understandings between Buyer and Seller with respect to the subject matter hereof, and no alteration or addition to this quotation shall be binding on Seller unless it is in a writing signed by Seller's duly authorized officer.

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Goodwyn Mills and Cawood
Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007
March 25, 2020

Proposal No. EM190346, Rev. 1

Price



Price

**Goodwyn Mills and Cawood
1450 Greene Street
Suite 505
Augusta, GA 30901**

**Attention:
Mitch Freeman, Senior Project Manager, Engineering**

**Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007**

March 31, 2020

**Proposal No. EM190346, Rev. 1
Prepared by: Brian Thomason**

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Goodwyn Mills and Cawood
Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
GMC Project # CSAV190007
March 25, 2020

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Price



**Goodwyn Mills and Cawood
Brunswick Glynn County Joint Water and Sewer Commission
2019 WPCF Rehabilitation – Academy Creek
Net Price
\$446,190.00**

Note: Progress Payment or Schedule of Values to be determined.

APPENDIX B-

CLOTH DISK FILTER EQUIPMENT SCOPE OF SUPPLY



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

June 17, 2020

Correspondence ID#: AAL-41075

ALL BIDDING CONTRACTORS

Attn: COST ESTIMATOR

Project: ACADEMY CREEK WPCP GA

RE: 2019 WPCF REHABILITATION ACADEMY CREEK 100% DESIGN
SUBMITTAL SPECIFICATION SECTION 46 61 23 DISK CLOTH TERTIARY
FILTRATION
AASI Project ID# 115157

To assist you in preparation of your bid for the referenced project, we are pleased to enclose our proposal for the Owner selected Aqua MegaDisk® Cloth Media Filter equipment, freight and supervision services for the above referenced project.

Please refer to our Proposal #152178 included at the end of Specification Section 46 61 23 for our lead-times, equipment terminations, and items not included in Aqua-Aerobic Systems' scope of supply which are to be provided by the Installing Contractor.

If you have any questions prior to the bid date, or if we can provide additional information, please do not hesitate to contact our representative.

Sincerely,

Jakob Nowicki
Project Applications Engineer

CC: Templeton & Associates / ph#: 770/614-8550 / fx#: 770/614-5992
Jon Baker / jon@templeton-associates.com

Aqua-Aerobic Systems, Inc.
Paul Nelson / PNelson@aqua-aerobic.com



AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Proposal#: 152178

TO: ALL BIDDING CONTRACTORS

PROJECT: ACADEMY CREEK WPCP GA

ATN: COST ESTIMATOR

PROPOSAL DATE: June 17, 2020

**CC: Templeton & Associates / ph#: 770/614-8550 / fx#: 770/614-5992
Jon Baker**

**Aqua-Aerobic Systems - Regional Manager / ph#: 815/639-4554 / fx#: 815/654-2508
Paul Nelson**

The following Notes apply to Aqua-Aerobic Systems' proposal:

- We are pleased to quote, for acceptance within 90 days of the proposal date, prices and terms on equipment listed below.
- Equipment will be furnished by Aqua-Aerobic Systems, Inc. with unloading of goods, civil work, and installation by the Buyer.
- Reference: Specification Section 46 61 23 - DISC CLOTH TERTIARY FILTRATION
- The equipment/goods furnished by Aqua-Aerobic will be as described in this proposal. The proposed Aqua MegaDisk® Cloth Media Filter equipment will provide the specified effluent objectives based upon the specified influent parameters per Specification Section 46 61 23, Paragraph 2.3.B. Design Criteria.

Cloth Media Filters

AquaDisk Tanks/Basins

2 AquaDisk Model # ADFSC-108x16E-PC Concrete Filter Basin Accessories consisting of:

- Concrete basins (by others).
- Overall footprint will be dependent on influent, effluent, and overflow chamber configurations.
- 304 stainless steel support brackets.
- Dual wheel support weldment(s).
- 304 stainless steel effluent seal plate weldment(s).
- Effluent seal plate gasket(s).
- Stainless steel anchors.

2 Influent & Effluent Weir Installation(s) consisting of:

- 20 ft long finger weir(s).
- Stainless steel anchors.

AquaDisk Centertube Assemblies

2 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Multi segment driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- Centertube bearing kit(s).
- Centertube support weldment(s).
- Centertube wall support(s).
- Bearing spacer plate(s).

- Viton V-ring effluent port\centertube seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Cloth will be 5 micron type OptiFiber PES-14.
- Disk segment 304 stainless steel support rods.

AquaDisk Drive Assemblies

2 Drive System(s) consisting of:

- Gearbox(es) with three phase 5 HP drive motor(s).
- Drive sprocket assembly(ies).
- 15-5 PH stainless steel drive chain(s) with 17-7 PH stainless steel link pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

2 Backwash System(s) consisting of:

- 304 stainless steel backwash shoe weldments.
- UHMW polyethylene backwash shoe nozzle plates.
- 304 stainless steel backwash shoe support weldment(s).
- 3" flexible hose.
- 304 stainless steel backwash collection manifold(s).
- PVC solids manifold installation(s).

2 Backwash/Solids Waste Pump(s) consisting of:

- Gorman Rupp model T6A60S, 20 HP, premium efficient, 3 phase externally mounted centrifugal pump(s).
- Painted 304 stainless steel backwash/waste pump stand.
- 0 to 30 psi pressure gauge(s).
- 6 inch diameter Milliken 601-N0 manual eccentric plug valve(s) with cast iron body, welded nickel seat, flanged end style, EPDM coated ductile iron plug, stainless steel bearings, and manual operator.
- 6" Krohne Enviromag series 2000 F magnetic inductive flow-meter with series IFC signal converter mounted integral to the meter.

AquaDisk Instrumentation

2 Pressure Transducer Assembly(ies) each consisting of:

- 304 stainless steel mounting bracket weldment(s).
- 304 stainless steel transducer pipe weldment(s).
- Pressure transducer(s).
- Stainless steel anchors.
- Nylon electrical cable tie wrap(s).

2 Vacuum Gauge with Transmitter(s) consisting of:

- 0 to 30 inches mercury vacuum gauge(s).
- Vacuum transmitter(s).
- 1/4" Threaded bronze ball valve.

2 Float Switch(es) consisting of:

- 316 stainless steel float switch mounting bracket(s).
- Float switch(es).
- Stainless steel anchor(s).

AquaDisk Valves

2 Set(s) of Backwash Valves consisting of:

- 6 inch diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

2 Solids Waste Valve(s) consisting of:

- 6 inch diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

2 Scum Removal Component(s) consisting of:

- 304 stainless steel scum weir(s).
- 8 inch diameter Milliken 601 electrically operated eccentric plug valve(s) with 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an Auma, 115 VAC, 60 hertz, single phase open/close service electric actuator. Valve actuator includes compartment heater.

AquaDisk Misc/Spare Parts**1 Lot of Recommended Spare Parts consisting of:**

- (2) Pile cloth media and non-corrosive support frame assemblies.
- (1) Viton V-ring effluent port/centertube seal(s).
- (1) 6 inch electrically operated plug valve(s) with single phase electric actuator(s).
- At least 1 of each fuse(s), control relay(s), and indicating light replacement bulb(s).

AquaDisk Controls w/Starters**2 Control Panel(s) consisting of:**

- NEMA 4X 304 stainless steel enclosure(s).
- Control panel sun shield.
- Air conditioner(s).
- Circuit breaker with handle.
- Transformer(s) with fuses.
- Circulation fan(s).
- GFI receptacle(s).
- Fuses and fuse blocks.
- Single phase circuit breaker(s).
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Selector switch(es).
- Indicating pilot light(s).
- PanelView plus 7 7 inch color touch screen display(s).
- Operator interface sun shield(s).
- Compactlogix Processor.
- Power supply(s).
- Input card(s).
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- Ethernet switch(es).
- Fiber optic patch panel(s).
- 20 HP VFD(s).
- 5 HP VFD(s).
- Power supply(ies).
- Terminal blocks.
- UL label(s).

AquaDisk Engineering**6 Set(s) Documentation for the AquaDisk will be provided as described:**

- Engineer's Approval Data (English language).

6 Set(s) Documentation for the AquaDisk will be provided as described:

- Operation & Maintenance Manuals (English language).

AquaDisk Supervision/Freight Domestic**1 Supervision Services and Freight Package(s) for the AquaDisk will be provided as follows:**

- 6 Day(s) On Site for INSTALLATION ASSISTANCE, INSPECTION, START-UP ASSISTANCE, AND TRAINING
- 2 Trip(s) for INSTALLATION ASSISTANCE, INSPECTION, START-UP ASSISTANCE, AND TRAINING
- FREIGHT TO JOBSITE

The Following General Notes apply to Aqua-Aerobic Systems' Proposal:

- SCHEDULE: We expect submittals to be completed and in transit to you within 4-8* weeks after receipt of order with acceptable terms and conditions and guarantee of payment. We expect receipt of approved engineer's submittal with release for manufacture within 4-8 weeks of our transmittal of submittal data. We expect shipment of equipment (transit time excluded) to be approximately 14-16* weeks from our receipt of approved engineer's submittal data and release for manufacture. Schedules may be adjusted at time of order placement, depending upon existing order backlog. *Weeks quoted are actual working weeks.
- Aqua-Aerobic Systems will be closed for the Christmas Holidays beginning approximately December 24, through approximately January 2nd.
- PRICE ESCALATION INDEX: Aqua-Aerobic Systems, Inc. reserves the right to re-evaluate the pricing quoted prior to order acceptance if; 1) a purchase order is received after the validity date stated in this proposal or, 2) the lead times stated in this proposal are exceeded. Any pricing adjustments required shall be based on a published materials cost index specific to the materials proposed.
- CONTROLS NON-DISCLOSURE / CONFIDENTIALITY AGREEMENT: If applicable, Aqua-Aerobic Systems will provide information relating to software documentation to control the treatment system supplied using Aqua-Aerobic Systems' proprietary and/or trade secret information subject to execution of an Aqua-Aerobic "Controls Non-Disclosure / Confidentiality Agreement".
- Additional supervision services can be provided for an additional charge of \$1200/day plus travel and living expenses.

The Following Mechanical and/or Electrical Notes apply to Aqua-Aerobic Systems' Proposal:

- Valve and line sizes are to be verified by the engineer based on actual line losses.
- Pumps and valves ship loose, unless otherwise specified.
- Filter flow hydraulics and plant's capability to handle the intermittent backwash flow is to be confirmed by the purchaser/purchaser's consulting engineer. Backwash flow is approximately 782 gpm per pump with an allowable discharge of 34 feet of water. Combined backwash discharge manifold must be design with all pumps running simultaneously.
- Three phase motors will be 460 volt.
- Single phase motors will be 115 volt.

The Following Scope Exclusion Notes apply to Aqua-Aerobic Systems' Proposal:

- Materials and Services not specifically described/itemized in this proposal are not included in the quoted total price, and are to be supplied by the installing contractor/purchaser.
- The filter equipment of this proposal is not rated for use in electrically classified areas.
- Freeze protection may be required for outdoor installation in cold weather climates. All such protection, including but not limited to, heat tracing and insulation of pumps and piping, as well as protection against internal tank freezing, shall be provided and installed by the installing contractor.

SCOPE BY PURCHASER/CONTRACTOR:

*Note this is not intended as a complete listing and is provided as a courtesy.

- Unloading and storage.
- Provisions for equipment access.
- Concrete, handrail and all civil works.
- All piping, spool pieces, supports, gaskets and hardware beyond Aqua-Aerobic's equipment terminations.
- Interconnecting piping, wiring and installation.
- All flanges and/or unions in the piping to service the equipment.
- Unless specifically stated above, weir(s) for each filter.
- Electrical conduit, hardware, supports, attachment of cables, wiring and j-boxes (if any) between motors, electrical valves, instruments and the control panel.
- Installation/field wiring of the control panel(s) that ship loose.

- Electrical wiring and supply power.

The Following Commercial Notes apply to Aqua-Aerobic Systems' Proposal:

TERMS AND CONDITIONS: AASI proposal terms and conditions have been included as interim terms and conditions. Aqua-Aerobic Systems reserves the right to negotiate mutually agreed upon terms and conditions with the Buyer to reflect the specifics of this project.

- **F.O.B. JOBSITE; TITLE AND RISK OF LOSS:** All prices and all shipments of goods are F.O.B. Jobsite City Location. It is the responsibility of the Buyer to unload shipments and utilizing the packing list and bill of lading provided with the shipment notate shortages/damages upon receipt of the shipments and notify Aqua-Aerobic in writing within 7 days of the shortages/damages to facilitate filing of a freight claim. Delivery of the goods sold hereunder by the carrier shall be deemed delivery to Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

- **TAXES:** State and/or local taxes are not included in the price but will be charged unless we receive a valid sales exemption certificate, direct pay permit, or other documentation required specifically by the taxing entity prior to shipment.

- **SCOPE OF SUPPLY NOTE:** Aqua-Aerobic Systems' scope of supply and pricing is as described in this proposal including the terms and conditions of sale, and is based upon the 2019 WPCF REHABILITATION ACADEMY CREEK 100% DESIGN SUBMITTAL Specification Section 46 61 23 Disc Cloth Tertiary Filtration and 100% DESIGN SUBMITTAL DRAWINGS DATED 3.12.2020. Please refer to the proposal notes for equipment terminations and items not included in the proposal which are to be provided by the Buyer. Engineer's submittal data will be prepared using these proposed goods and services, and the submittal approved by the Consulting Engineer will become an integral part of the scope of supply under the contract resulting from this offer. Any additions or deletions to the scope of supply will be presented as change orders.

- **TRADEMARKS:** Aqua-Jet®, Aqua-Jet II®, AquaDDM®, ThermoFlo®, Endura® Series, OxyMix®, OxyStar®, Fold-a-Float®, SAF-T Float®, Aqua MixAir®, AquaCAM-D®, AquaSBR®, Aqua MSBR®, AquaPASS®, Aqua BioMax®, AquaEnsure®, Aqua EnduraTube®, Aqua EnduraDisc®, Aqua CB-24®, AquaDisk®, AquaDiamond®, AquaDrum®, Aqua MiniDisk®, Aqua MegaDisk®, AquaPrime®, AquaStorm™, OptiComb™, OptiFiber®, OptiFiber PES-13®, OptiFiber PA2-13®, OptiFiber PES-14®, OptiFiber PF-14®, OptiFiber UFS-9®, Trust the Tag®, AquaABF®, AquaMB Process®, Aqua-Aerobic® MBR, Aqua UltraFiltration™, Aqua MultiBore®, Aqua Multibore® C-Series, Aqua Multibore® P-Series, Aqua ElectrOzone®, Aqua ElectrOzone® M-Series, IntelliPro®, Aqua-Aerobic®, and the Aqua-Aerobic Corporate logo artwork are registered trademarks or pending trademarks of Aqua-Aerobic Systems, Inc. Nereda®, AquaNereda® Aerobic Granular Sludge Technology, and the AquaNereda Product logo artwork are a registered trademark of Royal HaskoningDHV. All other products and services mentioned are trademarks of their respective owners.

GOODS QUOTED ABOVE WILL BE SOLD SUBJECT ONLY TO THE TERMS AND CONDITIONS OF SALE SET FORTH HEREIN. ANY DIFFERENT OR ADDITIONAL TERMS ARE HEREBY OBJECTED TO.

TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)**Page 1 of 2**

This offer and all of the goods and sales of Aqua-Aerobic Systems, Inc. are subject only to the following terms and conditions. The acceptance of any order resulting from this proposal is based on the express condition that the Buyer agrees to all the terms and conditions herein contained. Any terms and conditions in any order, which are in addition to or inconsistent with the following, shall not be binding upon Aqua-Aerobic Systems, Inc. This proposal and any contract resulting therefrom, shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to conflicts of laws principles.

PAYMENT

Unless specifically stated otherwise, quoted terms are Net 30 Days from shipping date. Past-due charges are 1.5% per month and will apply only on any past-due balance. Aqua-Aerobic Systems, Inc. does not allow retainage of any invoice amount, unless authorized in writing by an authorized representative of our Loves Park, Illinois office.

DURATION OF QUOTATION

This proposal of Aqua-Aerobic Systems, Inc. shall in no event be effective more than 30 days from date thereof, unless specifically stated otherwise, and is subject to change at any time prior to acceptance.

SHIPMENT

Shipping dates are not a guarantee of a particular day of shipment and are approximate, being based upon present production information, and are subject to change per the production schedules existing at time of receipt of purchase order. Aqua-Aerobic Systems, Inc. shall not be responsible for any delay in shipment for causes beyond its control including, but not limited to, war, riots, strikes, labor trouble causing interruption of work, fires, other casualties, transportation delays, modification of order, any act of governmental authorities or acts of God. Quoted shipment dates in this proposal are approximate dates goods will be shipped and, unless agreed to in writing by Aqua-Aerobic Systems, Inc., Buyer may not postpone or delay the dates of shipment of goods from our plant or from our supplier's plants beyond the dates set forth in this proposal.

TITLE AND RISK OF LOSS

All prices and all shipments of goods are F.O.B. Aqua-Aerobic Systems, Inc.'s plant at Loves Park, Illinois unless specifically stated otherwise. Delivery of the goods sold hereunder to the carrier shall be deemed delivery to the Buyer, and upon such delivery, title to such goods and risk of loss or damage shall be upon Buyer.

TAXES

Prices quoted do not include any taxes, customs duties, or import fees. Buyer shall pay any and all use, sales, privilege or other tax or customs duties or import fees levied by any governmental authority with respect to the sale or transportation of any goods covered hereby. If Aqua-Aerobic Systems, Inc. is required by any taxing authority to collect or to pay any such tax, duty or fee, the Buyer shall be separately billed at such time for the amounts Aqua-Aerobic Systems, Inc. is required to pay.

INSURANCE

Unless the goods are sold on a CIF basis, the Buyer shall provide marine insurance for all risks, including war and general coverage.

SECURITY

If at any time the financial responsibility of the Buyer becomes unsatisfactory to Aqua-Aerobic Systems, Inc., or Aqua-Aerobic Systems, Inc. otherwise deems itself insecure as to receipt of full payment of the purchase price from Buyer hereunder, Aqua-Aerobic Systems, Inc. reserves the right to require payment in advance or security or guarantee satisfactory to Aqua-Aerobic Systems, Inc. of payment in full of the purchase price.

LIMITATION OF ACTION

No action shall be brought against Aqua-Aerobic Systems, Inc. for any breach of its contract of sale more than two years after the accrual of the cause of action thereof, and, in no event, unless the Buyer shall first have given written notice to Aqua-Aerobic Systems, Inc., of any claim of breach of contract within 30 days after the discovery thereof.

CANCELLATION CLAUSE

No acceptance of this proposal, by purchase order or otherwise, may be modified except by written consent of Aqua-Aerobic Systems, Inc. nor may it be cancelled except by prior payment to Aqua-Aerobic Systems, Inc. the following sums as liquidated damages therefore: 1) If cancellation is prior to commencement of production and prior to the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to 15% of the total purchase price; 2) If cancellation is after the commencement of production or after the assumption of any obligations by Aqua-Aerobic Systems, Inc. for any materials or component parts, a sum equal to the total of the direct, out-of-pocket expenses incurred to the date of cancellation for labor, machine time, materials and any charges made to us by suppliers for cancellation, plus 30% of the total purchase price. All charges and expenses shall be as determined by Aqua-Aerobic Systems, Inc. In the event any items are used by Aqua-Aerobic Systems, Inc. to fill a subsequent order, then upon receipt of payment for such order, Aqua-Aerobic Systems, Inc. shall pay the Buyer a sum equal to the direct out-of-pocket expenses previously charged and received from Buyer.

PROPRIETARY INFORMATION

This proposal, including all descriptive data, drawings, material, information and know-how disclosed by Aqua-Aerobic Systems, Inc. to Buyer in relation hereto is confidential information intended solely for the confidential use of Buyer, shall remain the property of Aqua-Aerobic Systems, Inc. and shall not be disclosed or otherwise used to the disadvantage or detriment of Aqua-Aerobic Systems, Inc. in any manner.

TERMS AND CONDITIONS OF AQUA-AEROBIC SYSTEMS, INC. (A Metawater Company)

Page 2 of 2

QUALIFIED ACCEPTANCE AND INDEMNITY

In the event the acceptance of this proposal by Buyer either is contingent upon or subject to the approval by any third party such as, but not limited to, a consulting engineer, with respect to goods, parts, materials, descriptive data, drawings, calculations, or any other matter, then upon such approval by any third party, Aqua-Aerobic Systems, Inc. shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal. In the event any such third party requires modifications in the proposal prior to the approval thereof, Aqua-Aerobic Systems, Inc. may at its sole option and without liability to any party elect to cancel this proposal or return the purchase order to Buyer. In the event Aqua-Aerobic Systems, Inc. elects to modify this proposal to conform to the requirements for approval by any third party, Aqua-Aerobic Systems, Inc. in such event shall have no liability to Buyer or to any third party so long as the goods sold and delivered by Aqua-Aerobic Systems, Inc. conform to this proposal as modified.

Buyer agrees to indemnify and save harmless Aqua-Aerobic Systems, Inc. from and against all costs and expenses and liability of any kind whatsoever arising out of or in connection with claims by third parties so long as the goods sold hereunder conform to the requirements of this proposal as approved by any third party.

WARRANTY; LIMITATION OF LIABILITY; AND DISCLAIMER

In return for purchase and full payment for Aqua-Aerobic Systems, Inc. goods, we warrant new goods provided by us to be free from defects in materials and workmanship under normal conditions and use for a period of one year from the date the goods are put into service, or eighteen months from date of shipment (whichever first occurs). If the goods include an "Endura Series" motor, the complete Endura Series unit shall be warranted by Aqua-Aerobic to be free from defects in materials and workmanship under normal conditions and use for three years from the date the product is put into service or 42 months from the date of shipment (whichever occurs first).

OUR OBLIGATION UNDER THIS WARRANTY IS EXPRESSLY AND EXCLUSIVELY LIMITED to replacing or repairing (at our factory at Loves Park, Illinois) any part or parts returned to our factory with transportation charges prepaid, and which our examination shall show to have been defective. Prior to return of any goods or its parts to our factory, Buyer shall notify Aqua-Aerobic Systems, Inc. of claimed defect, and Aqua-Aerobic Systems, Inc. shall have the privilege of examining the goods at Buyer's place of business at or where the goods have otherwise been placed in service. In the event this examination discloses no defect, Buyer shall have no authority to return the goods or parts to our factory for the further examination or repair. All goods or parts shall be returned to Buyer, F.O.B. Loves Park, Illinois. This warranty shall not apply to any goods or part which has been repaired or altered outside our factory, or applied, operated or installed contrary to our instruction, or subjected to misuse, chemical attack/degradation, negligence or accident. This warranty and any warranty and guaranty of process or performance shall no longer be applicable or valid if any product, including any software program, supplied by Aqua-Aerobic Systems, Inc., is modified or altered without the written approval of Aqua-Aerobic Systems, Inc. Our warranty on accessories and component parts not manufactured by us is expressly limited to that of the manufacturer thereof.

THE FOREGOING WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND OF ALL OTHER LIABILITIES AND OBLIGATIONS ON OUR PART, INCLUDING ANY LIABILITY FOR NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE; AND ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY DISCLAIMED; AND WE EXPRESSLY DENY THE RIGHT OF ANY OTHER PERSON TO INCUR OR ASSUME FOR US ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ANY GOODS PROVIDED BY US. THERE ARE NO WARRANTIES OR GUARANTEES OF PERFORMANCE UNLESS SPECIFICALLY STATED OTHERWISE.

UNDER NO CIRCUMSTANCES, INCLUDING ANY CLAIM OF NEGLIGENCE, STRICT LIABILITY, OR OTHERWISE, SHALL AQUA-AEROBIC SYSTEMS, INC. BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, COSTS OF CONNECTING, DISCONNECTING, OR ANY LOSS OR DAMAGE RESULTING FROM A DEFECT IN THE GOODS. LIMIT OF LIABILITY: AQUA-AEROBIC SYSTEMS, INC.'S TOTAL LIABILITY UNDER THE ABOVE WARRANTY IS LIMITED TO THE REPAIR OR REPLACEMENT OF ANY DEFECTIVE PART. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE, AND OUR LIABILITY WITH RESPECT TO ANY CONTRACT OR SALE, OR ANYTHING DONE IN CONNECTION THEREWITH, WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, OR OTHERWISE, SHALL NOT, IN ANY CASE, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Final acceptance of this proposal must be given to Aqua-Aerobic Systems, Inc. at their office in Loves Park, Illinois. Please acknowledge acceptance by signing the proposal and returning it to Aqua-Aerobic Systems, Inc.

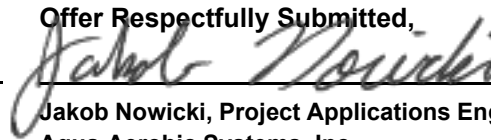
Accepted by:

Company: _____

By: _____

Date: _____

Offer Respectfully Submitted,



Jakob Nowicki, Project Applications Engineer
Aqua-Aerobic Systems, Inc.