Washington County
MARYLAND

PURCHASING DEPARTMENT
DIVISION OF BUDGET & FINANCE

**PUR-1623**
**ADDENDUM NO. 1**
**INVITATION TO BID**

**SMITHSBURG WwTP ENR UPGRADE AND EXPANSION**

**DATE: Friday, August 10, 2023**

**BIDS DUE: Wednesday, September 6, 2023**
**2:00 P.M.(EDT/EST)**

To Bidders:

This Addendum is hereby made a part of the Contract Documents on which all bids will be based and is issued to correct and clarify the original documents.

Please acknowledge receipt of this Addendum at the appropriate space on the Proposal Form. This Addendum consists of two (2) pages.

**NOTE: All Bidders must enter the Washington County Administration Complex through either the front door at the 100 West Washington Street entrance or through the rear entrance (w/blue canopy roof) which is handicap accessible and must use the elevator to access the Purchasing Department to submit their bid and/or to attend the Pre-Bid Conference. Alternate routes are controlled by a door access system. The general public will be subject to wand search and will be required to remove any unauthorized items from the building prior to entry. Prohibited items include but are not limited to: Weapons of any type; Firearms, ammunition, and explosive devices; Cutting instruments of any type - including knives, scissors, box cutters, work tools, knitting needles, or anything with a cutting edge, etc.; Pepper spray, mace, or any other chemical defense sprays; and Illegal substances.**

**ITEM NO. 1:** *Inquiry:* Is there an Estimate/Budge for this project?

*Response:* Engineer's estimate is $7.7M.

**ITEM NO. 2:** *Inquiry:* I do not see a completion schedule in the documents.

*Response:* Please refer to the Invitation to Bid document, Page 4, Information for Bidders, Item No. 26.

**ITEM NO. 3:** *Inquiry:* It looks like the specification manual does not include the divisional breakdown that is referenced in the table of contents.

*Response:* The technical specifications that were inadvertently omitted are included with this addendum.

**ITEM NO. 4:** *Inquiry:* The bidding documents available from the Washington County Commission website are missing the Technical Specification sections prepared by Buchart Horn listed in the table of contents. None of the 23 specification divisions are included with the bidding document. Where would I need to go to find them?

*Response:* The technical specifications that were inadvertently omitted are included with this addendum.

By Authority of:

Rick F. Curry, CPPO
Director of Purchasing

***(NOTE:** The wording of all "Inquiries" submitted are displayed exactly as received.)*

**SECTION 00 01 10**
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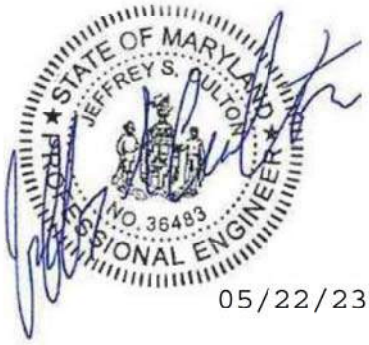

**END OF SECTION 00 01 10**

**SECTION 00 62 33.10**
**EQUIPMENT WARRANTY AND CERTIFICATION FORM**

**REFERENCE: WASHINGTON COUNTY DEPARTMENT OF WATER QUALITY - SMITHSBURG WWTP ENR UPGRADE AND EXPANSION**

The undersigned hereby attests that they have examined all the referenced project drawings and specifications and hereby warrants and certifies that the equipment, component, or system they propose to furnish and deliver meets or exceeds contract specifications, is suitable for its intended purpose and installation, and will provide satisfactory performance at the design criteria specified. This warranty shall be in addition to and not in lieu of all other warranties, express or implied.

Equipment: _____

Manufacturer:_____

Address: _____

_____

By: _____
(Typed/Printed Name and Title)
(Seal)

_____ _____
(Signature) (Date)

Equipment Warranty and Certification must be signed by a Principal Person (President, Vice President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must also sign this form.

Supplier: _____

Address: _____

_____

By: _____
(Typed/Printed Name and Title)
(Seal)

_____ _____
(Signature) (Date)

**END OF SECTION 00 62 33.10**

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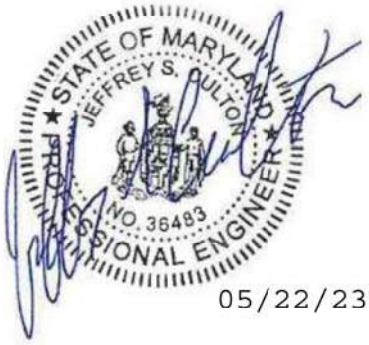


**END OF SECTION 00 01 10**

**SECTION 00 62 33.12**
**EQUIPMENT INSTALLATION CERTIFICATION FORM**

**REFERENCE: WASHINGTON COUNTY DEPARTMENT OF WATER QUALITY - SMITHSBURG WWTP ENR UPGRADE AND EXPANSION**

The undersigned hereby attests that prior to start-up and operation, they certify that the equipment, component or system they furnished, has been properly installed and lubricated under either the continuous or periodic supervision of the manufacturer's field representative, has been installed in accordance with the contract documents, approved shop drawings and product data including any notations, remarks or revisions by the engineer, to the manufacturers satisfaction. A copy of this certification shall be provided to the engineer prior to any operation of the said equipment.

Equipment: _____

Manufacturer:_____

Address: _____

_____

Equipment Installation Certification must be signed by a qualified technician of the equipment manufacturer or supplier.

Supplier: _____

Address: _____

_____

By: _____
(Typed/Printed Name and Title)
(Seal)

_____ _____
(Signature) (Date)

**END OF SECTION 00 62 33.12**

**SECTION 00 62 33.14**

**MATERIAL AND PRODUCT CERTIFICATE OF COMPLIANCE FORM**

**PROJECT: WASHINGTON COUNTY DEPARTMENT OF WATER QUALITY - SMITHSBURG WWTP ENR UPGRADE AND EXPANSION**

The undersigned manufacturer/fabricator/supplier hereby certifies the below listed material(s) or product(s) furnished by:

_____

(Name of Manufacturer, Fabricator or Supplier)

for this contract meets or exceeds the specified requirements.

| Material or Product Description | Specification Reference<br>Specification Page No. and Paragraph |
|---|---|
| | |
| | |

Manufacturer/Fabricator/Supplier: _____

Address: _____

_____

By: _____

(Typed Name and Title)

_____ _____

(Signature) (Date)

The undersigned contractor accepts this manufacturer/fabricator/supplier's certification of compliance and agrees to use this material/product in this contract work.

Contractor: _____

Address: _____

_____

By: _____

(Typed/Printed Name and Title)

_____ _____

(Signature) (Date)

**END OF SECTION 00 62 33.14**

**SECTION 01 00 00**
**GENERAL REQUIREMENTS**

## PART 1 GENERAL REQUIREMENTS

### 1.1 CONTRACT DOCUMENTS

A. The Contractor's obligations shall be as defined by its Agreement with the Owner.
B. The Engineer's responsibilities shall be as defined by its Agreement with the Owner.

### 1.2 SCOPE

A. The Contractor shall provide labor, materials, equipment and services, and perform all operations required for completion of Work of this Contract as specified and as indicated on the Contract Drawings.
B. Construction Contract:
   1. All building and tank construction work; process equipment, piping and control work; interceptor work; and site work as shown on Drawings, herein specified or both.

### 1.3 REFERENCED STANDARDS AND SPECIFICATIONS

A. Applicable Codes, Specifications and Standards: All references to codes, specifications and standards in the Contract Documents shall mean, and are intended to be, the latest edition, amendment and/or revision of reference standard in effect as of the date of bid opening for this Contract.
B. The Contractor shall maintain on the site copies of permits, local codes governing and applicable to the Contract work, American Association of State Highway and Transportation Officials Specifications, and Department of Transportation Standard Specifications for Maryland.
C. Where the publications, standards, codes or other material referenced in the specification are not required to be on site as specified in 1.3 (B), the Contractor shall, when requested by the Owner or Engineer, produce a copy of the standard, code, or specification within four (4) hours from the time of request.

### 1.4 PERMITS, FEES, AND CERTIFICATES

A. The Contractor will secure and pay for all construction permits and licenses, and will pay all governmental charges and inspection fees necessary for the prosecution of the Work, unless specifically stated otherwise.
B. The Contractor shall secure certificates of inspection for occupancy that may be required by authorities having jurisdiction over Work, including but not limited to AIA certificates, NEC, UL, ASME approvals, and deliver to the Owner through the Engineer.

### 1.5 COMPLIANCE WITH LAWS, ORDINANCES CURRENTLY IN EFFECT

A. Contractor shall comply with all applicable laws, ordinances and codes of the appropriate jurisdiction having control and effect upon the work of this Contract. Before installing any work, the Contractor shall inform himself on any law, ordinance or code affecting the work; and, where this law, ordinance or code is at variance with these specifications or drawings, the Contractor shall report the discrepancy to the Engineer in writing for his resolution to remove the discrepancy.

B. Should the Contractor elect to ignore the conditions stipulated in the paragraph above and proceed with the work or variance with any applicable ordinances or code, the Contractor shall remove such work without cost to the Owner and proceed with the work in a manner as specified by the Engineer.
C. Contractor shall comply with applicable laws and ordinances governing the disposal of surplus excavation, materials, debris and rubbish on or off the project and commit no trespass on any public or private property in any operation due to or connected with the work.

**1.6 TAXES**

A. The Contractor will pay all sales, consumer, use and other similar taxes required by the law of the place where the Work is to be performed.
B. The Owner will sign a sales tax exemption certificate for equipment and services provided under this contract which are determined to be tax exempt. The Contractor is responsible to make any necessary inquiries and investigations with regulating state agencies to obtain a determination of equipment and services which are tax exempt for this project and shall reflect any tax exemptions in his bid.

**1.7 CLASSIFICATION OF EXCAVATION**

A. All excavation, trenching, boring, jacking and tunneling work under this Contract shall be UNCLASSIFIED, and includes excavation and removal of all soil, rock, boulders, fill, and other materials encountered of whatever nature.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.1 CONTRACTOR'S USE OF PREMISES**

A. The Contractor shall confine construction equipment, the storage of materials and equipment, and operations of workmen to within areas of construction and areas approved by the Engineer and Owner.
B. The Contractor shall assume full responsibility for materials stored on site including materials for which the Owner has made payment. Purchase and maintain such additional amounts of insurance as are necessary to provide coverage against loss or damage to the materials.
C. The Contractor shall transport materials remaining at the completion of the project for which the Owner has made payment to a storage area designated on site by the Owner.
D. The Contractor shall perform his work in a neat manner and, upon completion, shall remove from the site all excess materials, trash and appurtenances not required to be incorporated in the finish work. The Contractor shall be required to effectively protect the portions of the existing facilities to remain; any resultant damage to existing remaining portions of structures, piping systems or equipment thereof shall be restored to conditions existing prior to execution of his work.

**3.2 REMOVAL, RELOCATION AND SALVAGE OF EXISTING EQUIPMENT AND BUILDING COMPONENTS**

A. Refer to Section 02 41 13 - Site Demolition.

**3.3 ORDER OF WORK**

A. Contractor shall make himself familiar with all alteration and renovation notes on Drawings and actual site conditions.

B. It shall be Contractor's responsibility to arrange with Engineer a schedule of operation, so as not to inconvenience the operation of the Owner's program.

C. The Contractor shall be responsible for the protection of the Owner's building, facilities and improvements within the areas where the work is being performed. Any disturbance or damage to the work being performed by the Contractor, a separate contractor, or to the existing building, improvements or equipment, or any other impairment of the Owner's facilities resulting from the Contractor's performance shall be promptly restored, repaired or replaced to the satisfaction of the Owner by the responsible prime Contractor at no extra cost to the Owner.

D. Contractor shall be responsible for performing his work in such manner so as to maintain essential ingress and egress for visitors and occupants to the Owner's building and facilities and to continuously maintain all required emergency exits from the circulation between existing facilities. Passageways for emergency exits shall be kept continuously open and free from debris, construction equipment, tools, materials or other hazards. The General Contractor shall provide all necessary temporary work which may be required to obtain and maintain all such ingress, egress and circulation requirements; temporary work shall be removed when no longer required.

E. Contractor shall commence the work and so schedule his work, through the Engineer, to avoid interference with the Owner's operations. Unavoidable interference with the Owner's operations shall not be carried out without the Owner's approval obtained not less than forty-eight (48) hours prior to the anticipated interference. The Contractor is advised that the Owner's operations during the school year are on an eight-hour day, five days per week basis.

F. Where existing building utilities such as gas, water, electricity or other facilities are required to be curtailed for making connections, extensions of services or other required work, all such work shall be scheduled with and approved by the Owner. All such work shall be scheduled so that it shall not interfere with the Owner's programs and may be done on weekends, after regular hours or as agreed upon by the Owner. All efforts and construction shall be coordinated so that any curtailment is held to a minimum. In the event any building services are interrupted for a period of time longer than two (2) hours, the Contractor shall, at his expense, provide a suitable temporary bypass to conduct his work and to maintain necessary building services.

G. To insure non-interference with the Owner's operations during the performance of the work, the Contractor shall remove from the building, facilities and improvements where the work is being performed all trash, combustible materials and debris of all kind being created during the performance of the work and upon completion of the work. This obligation shall also include all debris created by any subcontractors or materialmen engaged by the Contractor in performing the work. Such debris shall be disposed of to facilities furnished by the General Contractor.

**3.4 WORK HOURS**

A. Work shall occur between the hours of 7:00 a.m. and 4:30 p.m., Monday through Friday.

B. The Contractor must notify the Owner to obtain approval a minimum of two days prior to the need to work overtime hours or weekends. Overtime hours are defined as hours before 7:00 a.m. and after 4:30 p.m., Monday through Friday, and anytime on weekends and holidays.

**3.5 CLEANING UP**

A. The Contractor shall continuously keep the work, the site and adjacent properties free from accumulations of waste materials, excess excavation, rubbish and windblown debris resulting from construction operations. Remove waste materials, excess excavation, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the project site. Handle excess excavation as defined by Division 31 of Technical Specifications.

B. The Contractor shall remove grease, mastics, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from site-exposed interior and exterior surfaces of structures. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds. Restore areas disturbed by construction. Provide continuous dust control during construction. Maintain temporary paving areas during the period prior to permanent paving.

C. At the completion of the work, or each major portion thereof, the Contractor shall remove surplus materials, tools, construction equipment and machinery, and leave the site clean and ready for occupancy by the Owner. Upon completion of construction, clean and flush existing storm drains in the area of construction.

D. The Contractor shall maintain his area of work. If clean-up is not complied with, 10% of the succeeding progress payments, in addition to the normal contract retainage, will be withheld from the responsible Contractor until such clean-up is performed.

E. The Contractor shall be responsible for providing dumpsters for the collection and disposal of waste and debris, including for hazardous or unsanitary waste materials; location of dumpsters shall be proposed by the Contractor and approved by the Owner. Comply with NFPA 241 for removal of combustible materials. Hazardous materials shall be containerized for removal from site.

F. Final cleaning shall be as specified in Section 01 70 00 - Project Closeout.

**3.6 HISTORICAL/ARCHAEOLOGICAL FINDS**

A. If during the course of construction evidence of deposits of historical or archaeological interest is found, cease work affecting find and notify the Engineer. Do not disturb deposits until written notice from Engineer is given to proceed. Compensation for lost time or changes in construction to avoid the find will be made based upon normal change order procedures.

**3.7 CONSTRUCTION STAGING AREA**

A. Area location for Contractor's field office, equipment storage, fabrication, vehicle parking, and Engineer's field office and parking will be proposed by the Contractor and approved by the Owner.

**END OF SECTION 01 00 00**

**SECTION 01 14 00**
**SPECIAL REQUIREMENTS**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Contractor shall provide labor, materials, equipment and services, and perform all operations required for completion of Work of this Contract as specified and as indicated on the Contract Drawings.

B. This section supplements the General Requirements provided by Section 01 00 00.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.1 MAINTENANCE OF PLANT OPERATIONS

A. New Metering Manhole
   1. The installation of the new metering manhole on the existing 15-inch plant influent line will require bypass pumping from the existing screens to Manhole 3. The bypass pump capacity shall be 1,569 gpm.

B. New Chemical Building
   1. The Contractor shall construct the new Chemical Building prior to commissioning new equipment at the Influent Equalization Tank and Pre-Anoxic Tank. Electrical gear for this equipment and for the new Influent Pumping Station Pumps is located in the Chemical Building and must be installed prior to commissioning of that equipment.

C. New Influent Equalization Tank
   1. The new Influent Equalization Tank, Pre-Anoxic tank, associated yard piping, and pinch valve and metering vault shall be constructed and commissioned prior to taking one of the SBR tanks out of service for renovations or bypassing the influent pumping station wet well. With concurrence from the Owner, the Contractor may choose to utilize the new Influent Equalization Tank to receive raw wastewater and serve as the bypass pumping wet well during work at the existing Influent Pumping Station and SBRs.

D. Influent Pumping Station Upgrades
   1. The Contractor shall construct and commission the new Pre-Anoxic Tank, new Influent Equalization Tank, pinch valve and metering vault, and associated process equipment prior to working on the existing Influent Pumping Station.
   2. The Influent Equalization Pumps must be installed and operational prior to working on the existing Influent Pumping Station, valve vault or SBRs.
   3. The installation of the new sanitary metering manhole on the plant influent line and tie-in of new Pre-Anoxic influent piping into the existing 15-inch plant influent will require bypass pumping from Manhole 3A to the Influent Pumping Station. The bypass pump capacity shall be 1,569 gpm.
   4. Currently, one MRAS pump operates at a time so that MRAS is continuously flowing to the Influent Pumping Station. Connection to the existing buried MRAS line from the new Pre-Anoxic Tank must be scheduled with the WWTP during a time when sludge wasting is not required for up to 24 hours. The Contractor shall have 8 hours to make this connection.

5. The replacement of the existing Influent Pumping Station Pumps and valves will require bypass of the influent pumping station wet well and valve vault. Bypass pumping will be from the new Influent Equalization Tank and from the Pre-Anoxic tank to the SBRs. The tie-in of the new 16-inch line from the new Pre-Anoxic Tank to the Influent Pumping Station shall also occur at this time. The bypass of the influent pumping station wet well shall take place when one SBR is out of service (as described below) to simplify bypass pumping. The bypass pumping shall be configured to allow storage in the Influent Equalization tank to allow the batch cycle to the SBR to continue to the extent possible with feed from the new Influent Equalization Tank to the SBR only during fill mode unless the water level in the Equalization Tank reaches the Equalization Tank high water level. The Contractor shall be required to provide temporary pump controls for the new Influent Equalization Pumps to accomplish this. Bypass pumps shall also be used to pump from the Pre-Anoxic tank to the SBR and these pumps shall operate continuously to convey MRAS. The bypass of the influent pumping station wet well shall occur after the new plant influent flow meter has been installed and commissioned. The design capacity of the bypass pumps conveying flow from the new Influent Equalization Tank to the SBR shall be 1181 gpm. The design capacity of the bypass pump system conveying flow from the Pre-Anoxic zone to the SBR shall have a peak capacity 611 gpm with typical operation at 200 gpm.
6. The Contractor shall submit a comprehensive work plan for the Influent Pumping Station Upgrade. No work shall occur until the plan is approved.

E. SBR Tanks and New Blowers:
1. The Contractor shall install the new SBR control panel prior to taking either SBR out of service for demolition of existing equipment and installation of new equipment.
2. The Contractor shall install the new blowers and air piping to the top of the air piping drop-legs prior to beginning demolition of existing SBR equipment. The new blower VFDs shall be installed at this time as well. The new blowers must be operational by the time installation of new equipment is complete in the first SBR to be taken out of service for upgrades.
3. Only one SBR tank shall be out of service at any one time. A SBR tank may be out of service for up to three weeks. The Contractor shall allow for two weeks' time duration per SBR tank for taking each SBR out of service. The Contractor shall be responsible for transferring the MLSS from one SBR tank to the other.
4. The Contractor shall provide bypass pumps configured to pump from the new Influent Equalization Tank to the SBR. The bypass pumping shall be configured to allow storage in the Influent Equalization tank for the batch cycle to the SBR to continue to the extent possible with feed from the new Influent Equalization Tank to the SBR only during fill mode unless the water level in the Equalization Tank reaches the Equalization Tank high water level. The design capacity of the bypass pumps conveying flow from the new Influent Equalization Tank to the SBR shall be 1181 gpm.
5. The Contractor shall submit a comprehensive work plan for the SBR Upgrades. No work shall occur until the plan is approved.

F. Control Building Modifications
1. The Contractor shall furnish a temporary generator while demolition in generator room occurs for the installation of new electrical equipment. The temporary generator shall remain in service until the new generator is installed, operational and accepted.

G. Operations Building Modifications:
   1. Only one Post-Equalization pump shall be out of service at one time. Each pump and corresponding VFD shall be replaced in turn.
   2. Bypass pumping is required for the replacement of Post-Equalization pump discharge valves and flow meter. Bypass pumping from the post-equalization wet well to the filters is required and shall be provided by the Contractor. The design flow for the bypass system is 1,569 gpm.
   3. Only one Disc Filter tank shall be out of service for interior coating at one time.
   4. The Contractor shall submit a comprehensive work plan for the Operations Building Upgrades. No work shall occur until the plan is approved.

H. UV Disinfection:
   1. The existing UV channel shall be taken out of service during the installation of the new system.
   2. The Contractor shall provide a portable UV treatment system, as shown in Appendix A, Drawing No. PM-17, and as described in the contract specifications. Tie into the existing filter bypass piping with a gate valve and tee running temporary piping into the portable UV system. Run 12" temporary piping from the portable UV system to the utility water manhole.
   3. The portable UV system will be used while the new UV system is being installed within the existing channels.

I. Maintenance of Electrical Power.
   1. Electrical power must be maintained to the treatment plant process equipment at all times. If the main electrical service power is interrupted, standby power must be on-line. The maximum duration of the utility power can be off-line is four (4) hours.
   2. Before the existing standby generator is taken out of service, the new standby generator must be fully operational.
   3. If temporary electrical generators are being utilized, provide an adequate fuel supply at all times and generator power output cables must be connected to the power distribution equipment at all times. Temporary electrical generation equipment must be protected from and able to operate in inclement weather.
   4. All temporary electrical power distribution equipment and electrical generation equipment must be properly grounded.
   5. The Contractor is responsible for providing temporary wiring as necessary to maintain operation of plant equipment
   6. The Contractor shall plan the electrical work described in the documents to the sequence of construction described in this section.
   7. The Contractor shall submit a written plan for review by the Owner and Engineer for all planned power outages, describing outage durations, affected equipment, and temporary measures being provided to keep process equipment operational. Describe safety procedures, grounding methods, and cable testing that will be provided. Electrical testing shall be performed in accordance with Specification Section 26 90 00 before placing equipment into service.

J. General:
   1. The Contractor shall maintain operator access to all treatment plant processes at all times.
   2. No tanks or process system shall be taken out of service without the Owner's written approval. The Contractor shall submit a written request to the Owner and give the Owner a minimum of three (3) weeks, unless otherwise noted, prior notice to coordinate and revise plant operational

procedures to accommodate the change, thereby enabling approval of the Contractor's request.

3. Under no circumstances will the Contractor allow raw or improperly treated wastewater to be discharged on the construction site or surrounding grounds. Any accidental discharge shall be reported to the Owner immediately.
4. The above items have listed the major portions of the suggested procedures necessary to maintain operation of the treatment facility. There may be additional instances where temporary measures (Equipment, piping, wiring, bypass pumping, temporary bulkheads, etc.) are necessary to maintain plant operations and/or the construction sequence. The Contractor is responsible for all costs to provide these temporary measures and these costs shall be included in the Contractor's lump sum price for this project.
5. The Contractor shall submit a written description and time schedule for maintaining plant operations.

K. New Utility Water Pump Station Manhole

1. The installation of the new utility water pump station manhole on the existing 12-inch plant effluent line will require bypass pumping from the existing filter bypass piping to existing effluent manhole 1. Connect to existing filter bypass piping as shown on drawing PM-17 for use with portable UV system. The bypass pump capacity shall be 1,615 gpm.
2. The new utility water pump station manhole must be installed and operational prior to operation of the portable UV system.

**3.2 EXISTING TANK DEWATERING AND CLEANOUT**

A. The Contractor will be responsible for the dewatering of all tanks to be taken out of service for renovation. The Contractor will drain or pump liquid from the tanks. Liquid remaining in the SBRs below the decant level will be pumped into the adjacent SBR. The rate of tank drain flow shall be coordinated with the Owner so as to not exceed a flow rate that would upset the plant process. The Contractor will be responsible for removal of liquid sludge and grit remaining in the bottom of the units. The Contractor will be responsible for providing the necessary manpower, pumps, hoses, squeegees, etc. to slurry and push liquid to existing drains, sumps, or low points so that it can be removed.

B. Grit and packed inert materials, if found, shall not be slurried and drained from the tanks. Such materials shall be physically hauled from the tanks by the Contractor and either drained or bulked with approved inert materials to achieve landfill disposal requirements. The Contractor shall provide its own dumpsters for material disposal. For solids materials removed during the cleaning operation the Contractor may dispose of this material at the Washington County Landfill. Use of the Owner's permit is allowed given the following conditions are met:

1. The material may not contain free liquids.
2. The material must pass the paint filter test.
3. Certified weight slips for all residuals removed from the plant on a daily basis are to be provided to the Owner.
4. The Contractor must set up its own payment terms with the landfill. All costs of disposal are to be included in the lump sum bid for the Contract.
5. The Owner will provide a signed manifest upon visual examination of each load to verify there is no free-standing water.

6. If the Washington County Landfill is not used as a disposal site, the Contractor must provide certification documents indicating disposal compliance with Federal, State and local regulations for any other site receiving the solids.

C. Once all liquid, sludge, and grit have been removed, the Contractor shall clean the interior walls and floor, including hoppers, of each tank by squeegeeing and hosing with water to remove all sludge, grease, and dirt deposits to the satisfaction of the Owner's representative. The Contractor shall also thoroughly flush all drain lines.

D. The following is a list of assumed volumes of grit and inert materials remaining in the tank or pit after completion of dewatering by the Contractor and for which the Contractor will be responsible for its removal:

| Structure | Volume of Material to be Removed (Cubic Yards) |
|---|---|
| SBR 1 | 90 |
| SBR 2 | 90 |
| Influent PS Wet Well | 1 |

**END OF SECTION 01 14 00**

**SECTION 01 22 00**
**MEASUREMENT AND PAYMENT**

## PART 1 GENERAL

### 1.1 SCHEDULE OF VALUES

A. The Contractor shall submit a Schedule of Values for the Work of the Contract, including quantities and unit prices aggregating the Lump Sum Contract Price.

B. If any unit price in the approved Schedule of Values requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the Specifications.

### 1.2 MEASUREMENT OF QUANTITIES

A. Work completed under the Contract shall be measured according to the standards of weights and measures recognized by the U.S. Bureau of Standards.

B. The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

C. Measurement for area computations will be made on the surface. Pay measurements for area computations will not exceed the neat dimensions indicated on the Contract Drawings, unless otherwise ordered in writing by the Engineer.

D. Structures will be measured according to neat lines indicated on the Contract Drawings or as altered to fit field conditions. No payment will be made for length, width, or depth, in excess of that indicated on the Contract Drawings or specified for any construction, unless otherwise approved by the Engineer in writing.

E. Items which are measured by the linear foot, such as pipe, will be measured parallel to the base or foundation upon which such items are placed.

F. In computing volumes of excavation, the average end area method, based on horizontal measurements, or other acceptable methods, will be used.

G. The term "each", when used as an item of payment, will mean complete payment for the Work described in the Contract Documents.

H. The term "lump sum", when used as an item of payment, will mean complete payment for the Work described in the Contract Documents, including all necessary fittings and accessories, and required testing completed.

I. The term “complete in place”, means the completion of the Contract item or portions thereof as determined by the Engineer including the furnishing of all materials, equipment, tools, labor, and work incident thereto, unless otherwise specified.

J. Contingent unit price items work is work not shown on the Contract Drawings and shall be performed only at the direction of the Engineer.

### 1.3 SCOPE OF PAYMENT

A. The Contractor will receive and accept compensation provided for in the Contract Documents as full payment for furnishing materials, labor, tools, and equipment and for performing Work under the

Contract in a complete and acceptable manner and for all risk, loss, damage, or expense of whatever character arising out of the nature of the Work or the execution thereof, subject to the provisions of the General Conditions.

B. Mobilization:
   1. When included in the Contractor's Schedule of Values, mobilization shall consist of the assembling and setting up for the project, the Contractor's necessary general plant, including Contractor's offices, Engineer's field office, shops, plants, storage areas, sanitary and any other facilities, as required by the Specifications and special requirements of the Contract, as well as by local or State law and regulation. The determination of the adequacy of the Contractor's facilities, except as noted above, shall be made by the Contractor. The cost of required insurance and bonds and/or any other initial expense required for the start of Work will be included in this item. The Contractor shall furnish all materials and furnishings required, and these materials and furnishings will not be considered as part of the other various items of the completed Contract.
   2. No additional payment will be made for demobilization. Costs for demobilization shall be included in this item.
   3. Mobilization will be paid at the approved lump sum price for mobilization and demobilization included in the Contractor's Schedule of Values. The lump sum price for this item shall be payable to the Contractor in accordance with the following schedule:
      a. On the first monthly application for Progress Payment, the amount approved for mobilization or three percent of the total Contract Price, excluding the price for this item, whichever is less, will be paid.
      b. Whenever Work performed equals 25 percent of the total Contract Price excluding the approved price for this item, any remaining amount for mobilization, or an additional two percent of the total Contract Price excluding the approved price for this item, whichever is less, will be paid.
      c. Upon completion of the Project, any remaining amount approved for mobilization will be paid.

**PART 2 PRODUCTS (NOT APPLICABLE)**

**PART 3 PRODUCTS (NOT APPLICABLE)**

**END OF SECTION 01 22 00**

**SECTION 01 29 76**
**APPLICATIONS FOR PAYMENT**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
   1. Coordinate the Schedule of Values and Application for Payment with the Construction Schedule, List of Subcontracts, and Submittal Schedule.

### 1.2 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with preparation of the Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
      a. Construction Schedule
      b. Application for Payment form
      c. List of subcontractors
      d. List of products
      e. List of principal suppliers and fabricators
      f. Schedule of submittals

B. Submit the Schedule of Values on AIA Document G703 in accordance with the General and Conditions. The Engineer and Owner shall review and approve the proposed Schedule of Values. Provide a breakdown of values by each location or building where the work will take place.

C. Format and Content: Use the Project Manual Table of Contents as a guide to establish the format for the Schedule of Values.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project Name
      b. Engineer Name
      c. Project No.
      d. Owner's Name
      e. Contract No.; Contract Name
      f. Contractor's name and address
      g. Date of submittal

D. Arrange the Schedule of Values in a tabular form with separate columns to indicate the following for each item listed:
   1. Generic name
   2. Related Specification Section
   3. Name of subcontractor
   4. Name of manufacturer or fabricator
   5. Name of supplier
   6. Change Orders (numbers) that have affected value
   7. Dollar value
   8. Percentage of Contract Sum to the nearest one-hundredth percent, adjusted to total 100 percent

E. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.
F. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
G. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent state of completion, and for total installed value of that part of the Work.
H. Schedule Updating: Update and resubmit the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum.

**1.3 APPLICATIONS FOR PAYMENT**

A. Applications for Payment shall be submitted on AIA G702 or forms distributed by the Engineer at the Preconstruction Conference.
B. Each Application for Payment shall be consistent with previous applications and payments as certified by the Engineer and paid by the Owner.
   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application of Payment involve additional requirements.
C. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal document on behalf of the Contractor. Incomplete applications will be returned without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.
D. Transmittal: Submit three executed copies of each Application for Payment to the Engineer.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application in a manner acceptable to the Engineer.
E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following.
   1. Schedule of Values
   2. Submittal Schedule (preliminary if not final)
   3. List of Contractor's staff assignments
   4. List of Contractor's principal consultants
   5. Initial progress report
F. Progress Payments: Monthly applications submitted by the date established at the preconstruction conference for the completed value of the work will be paid by the Owner on a date established at the preconstruction conference in the amount recommended by the Engineer.
   1. Owner reserves the right to modify this arrangement as required to accommodate meetings and approvals.
G. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy or designated portions of the Work. The

following administrative actions and submittals shall precede or coincide with this application.

1. Occupancy permits and similar approvals
2. Warranties (guarantees) and maintenance agreements
3. Test/adjust/balance records
4. Maintenance instructions
5. Start-up performance reports
6. Change-over information related to Owner's occupancy, use, operation and maintenance
7. Final cleaning
8. Application for reduction of retainage and consent of surety
9. Advice on shifting insurance coverages
10. List of incomplete Work, recognized as exceptions to Engineer's Certificate of Substantial Completion

H. Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the Final Application for Payment include the following.

1. Completion of Project closeout requirements
2. Completion of items specified for completion after Substantial Completion
3. Assurance that unsettled claims will be settled
4. Transmittal of required Project construction records to Owner
5. Proof that taxes, fees and similar obligations have been paid
6. Removal of temporary facilities and services
7. Removal of surplus materials, rubbish and similar elements

I. Schedule of Values must be approved by the Owner and Engineer before submittal of first application for payment.

**1.4 PAYMENT FOR EQUIPMENT AND MATERIALS STORED ON SITE**

A. Payment for equipment and materials stored on site shall be made subject to the terms and conditions as defined below:

1. Payment will be made for equipment and materials stored on the site, if approved by the Engineer, and under the following conditions:
   a. Payment will be made for the value of equipment or material only, not installed.
   b. For equipment items stored on site, the Contractor may request payment by submitting an invoice which identifies the cost of the equipment with the monthly Application for Payment. If approved for payment, the Engineer will recommend payment to the Owner. The Contractor must then submit to the Engineer proof of payment to the equipment supplier in the form of a certified paid invoice within 30 days of the receipt of payment to the Contractor from the Owner. In addition, the Contractor will certify at that time the item stored on site has been paid for, is free and clear of all liens and encumbrances, and that title for such item shall pass to the Owner. If proof of payment to the supplier and the above certification are not received within 30 days, the value of the equipment will be deducted from the subsequent Application for Payment. By requesting payment for these items, the Contractor agrees to incorporate these items into the construction of the project within 120 days of the

payment request. If approved for payment, the Engineer will recommend payment to the Owner.

c. Equipment storage requirements will remain unchanged as follows:
   1) The Contractor shall follow equipment storage requirements outlined herein before. The Contractor will be responsible to establish a system and provide for identification of items for which payment is made while stored on site subject to the approval of the Engineer. The Contractor shall provide documentation described above prior to requesting payment.

d. Insurance requirements will remain unchanged as follows:
   1) The Contractor shall retain responsibility for material stored on or off site and shall purchase and maintain insurance in the full value of the material stored on or off site in the name of the Owner. Such insurance will insure against loss and/or damage on an all-risk basis. Proof of insurance must be submitted prior to requesting payment.

e. Method of calculating percentage of completion of work will remain unchanged as follows:
   1) Payment made to Contractor for materials and equipment stored at the site, but not yet incorporated into the work, shall not be included in any computation to determine the percentage of completion of the work for the purpose of retained percentage.

**PART 2 PRODUCTS (NOT APPLICABLE)**

**PART 3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION 01 29 76**

**SECTION 01 30 00**
**ADMINISTRATIVE REQUIREMENTS**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Administrative Submittals
   2. Shop Drawings
   3. Material and Product Certificate of Compliance Form
   4. Product data
   5. Samples
   6. Manufacturer's equipment certification
   7. CPM Schedule
   8. Design Drawings
   9. Daily Log
   10. Installation Certificates
   11. Submittal procedures

B. Related Requirements:
   1. Section 01 29 76 - Applications for Payment
   2. Section 01 60 00 - Material and Equipment
   3. Section 01 70 00 - Project Closeout

### 1.2 PREPARATION OF SUBMITTAL

A. Provide a permanent label, title block or transmittal letter for each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

B. Include the following information on the label or transmittal letter for processing and recording action taken:
   1. Project Title
   2. Date
   3. Buchart Horn, Inc., 445 West Philadelphia St., York, PA.
   4. Name and address of Contractor
   5. Name and address of subcontractor
   6. Name and address of supplier
   7. Name of manufacturer
   8. Number and title of appropriate Specification Section
   9. Drawing number and detail references, as appropriate
   10. Contract Name

C. Provide a space approximately 8 inches by 4 inches on the label or beside the title block on Shop Drawings to record the Contractor's review and approval prior to submitting to the Engineer.

D. Submittals that fail to conform to these requirements will be returned without any action for correction by the Contractor. No extension of Contract Time will be authorized because of submittals being returned without action because of failure to comply with these regulations.

E. Package each submittal appropriately for transmitting and handling.

F. Transmit each item with a transmittal letter similar to AIA Form G810. Identify Project, Contractor, subcontractor, major supplier; identify pertinent Drawing sheet and detail number, and Specification Section number; identify deviations from Contract Documents. Provide space for Contractor and Engineer review stamps.

**1.3 COORDINATION AND SCHEDULING**

A. Schedule: Submit a schedule for all submittals; indicate the date of submittals and date of return. The first application for payment will not be approved until an acceptable schedule is received by the Engineer.
B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay. Submittals are to be transmitted to the Engineer.
C. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.
D. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
E. Schedule a minimum of four (4) weeks for handling and review for each submittal. Schedule additional time for review if submittal must be coordinated with subsequent submittals.
F. No extension of Contract Time will be permitted because of failure to transmit submittals sufficiently in advance to permit processing on a timely basis.
G. If a submittal must be delayed, the Engineer will inform the Contractor making the submittal and any Contractors affected by the delay.

**1.4 ADMINISTRATIVE SUBMITTALS**

A. Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
   1. Permits
   2. Applications
   3. Performance and payment bonds
   4. Insurance certificates
   5. List of subcontractors
   6. Critical Path Model (CPM) schedules
   7. Daily construction reports
   8. Material Safety Data Sheet (MSDS) documents
   9. Shop Drawing Submittal Schedule
B. The Schedule of Values submittal is included in Section "Applications for Payment".

**1.5 SHOP DRAWING SUBMITTALS**

A. Submit shop drawings to the Engineer. The Engineer will not review shop drawings if the following is not provided:
   1. A properly completed Equipment Certification Form or Material and Product Certificate of Compliance Form.
   2. Contractor's review and approval stamp is not provided on the submittal.

3. Contractor has not marked the submittal as “Submitted as Specified” or “Submitted as Equal to Specified”.

B. At the time of submission, call to the Engineer's attention, in writing, any deviations that the shop drawings may have from the requirements of the Drawings and Specifications. Any deviations which are not brought to the Engineer's attention which result in incomplete work will be required to be corrected and cost fully borne by the Contractor including costs incurred by the Engineer and Owner.

C. Submit shop drawings marked as either "Submitted as Specified" or "Submitted as Equal to Specified."

1. Where any article is specified by trade name or name of manufacturer with the clause "or equal", it is intended to establish the quality of the article. If the Contractor proposes to use material or equipment of another manufacturer as an "or equal" to the specified material or equipment, all shop drawings shall conform to the following requirements, conditions, and procedures:

a. Substitution of equipment or materials other than those specified will be permitted, providing, in the opinion of the Engineer, such equipment or material is equal to or better than that specified. The decision of the Engineer with respect to approval or disapproval of any material or equipment proposed to be substituted as an "or equal" is final. The Contractor shall have no claim of any sort by reason of such decision.

b. If the Contractor proposes to substitute materials or equipment as "or equal" to those specified, it shall be his responsibility to furnish complete, specific, detailed information from the manufacturer or supplier of the material or equipment he proposes to furnish, in which the requirements of the Contract Specifications are shown to be met. This shall consist of a point by point comparison of the Contract Specification requirements with the material or equipment proposed to be furnished. In the event the Contract Specifications mention a model number or other designation and manufacturer in lieu of the detailed description and manufacturer, a point by point comparison of the equipment specified under the Contract and that proposed to be substituted shall be furnished. The burden of responsibility to furnish this information is with the Contractor. If incomplete or irrelevant data is submitted as evidence of compliance with the Contract Specifications, the data will be returned and the request for substitution will be denied.

D. Submit all shop drawing information in a timely fashion to allow a thorough review by the Engineer and to ensure that delivery of the equipment coincides with the construction schedule. Failure of the shop drawings to comply with the specifications, requiring subsequent resubmittals, may adversely affect the construction schedule. Any such delays are solely the responsibility of the Contractor. The Owner and Engineer will not entertain or approve any claims by the Contractor for additional costs or extensions of contract time based on failure to obtain the Engineer’s review of shop drawings.

E. The Engineer's comments will include specific details as to what or where the shop drawings do not comply with the Drawings or Contract Specifications. The Engineer shall review only such data and details as are transmitted to him by the Contractor. The Contractor shall coordinate between all suppliers and subcontractors.

F. Four (4) copies of the reviewed shop drawings will be retained by the Engineer.

G. The Contractor's attention is specifically directed to the fact that no items shall be fabricated, nor equipment or materials ordered, nor any construction performed until a shop drawing is received from the Engineer with a "No Exception Taken" or "Make Corrections Noted - Resubmittal Not Required" stamp.

**1.6 MATERIAL AND PRODUCT CERTIFICATE OF COMPLIANCE FORM**

A. Submit certification of compliance of materials and products on the form provided. See Section 00 62 33.14. Submit certificate when indicated in the individual technical section.

**1.7 PRODUCT DATA**

A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and article number. Show reference standards, performance characteristics and capacities, wiring and piping diagrams and controls, component parts, finishes, dimensions, and required clearances.

B. Modify manufacturers' standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.

C. Manufacturers' Instructions: When required in individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation start-up, adjusting and finishing in quantities specified for product data.

**1.8 SAMPLES**

A. Submit full range of manufacturers' standard finishes except when more restrictive requirements are specified, indicating colors, textures and patterns, for Owner selection.

B. Submit samples to illustrate functional characteristics of products, including parts and attachments.

C. Accepted samples which may be used in the work are indicated in the Specification Sections.

D. Label each sample with identification information same as required for transmittal letter.

E. Provide field samples of finishes at the Project site, at location acceptable to Engineer, as required by the individual Specification Sections. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

**1.9 MANUFACTURER'S EQUIPMENT CERTIFICATION**

A. At the time of submitting Shop Drawings, when required by the individual technical specifications, submit a certification, in the form provided in Section 00 62 33.10, from each manufacturer of the equipment or system listed below attesting that the manufacturer has examined the Contract Drawings and Specifications and that the proposed equipment, component, or system meets or exceeds Contract Specifications, is suitable for its intended purpose and installation, and will provide satisfactory performance at the design criteria specified. Submit for the following:

**1.10 DESIGN DRAWINGS**

A. Where delegated design is indicated in the technical specifications, submit Design Drawings prepared by a Professional Engineer registered in the State of Maryland.

**1.11 CPM SCHEDULE**

A. The overall schedule shall indicate the sequence of work, and the time of starting and completion of each part. It shall include but not be limited to the following items as they pertain to the respective Contractors:
   1. Shop drawing receipt from manufacturer, submittal to the Engineer, review, and return to Contractor
   2. Material and equipment order, manufacture, delivery, installation, and check-out
   3. Performance tests and supervisory service activities
   4. Mobilization
   5. Bypass Pumping, if required.
   6. Temporary Construction
   7. Dewatering
   8. Interim Milestones or Phases
   9. Piping, ductwork, and wiring installation
   10. Demolition work
   11. Construction of various facilities
   12. Concrete placement sequence
   13. Backfilling, grading, seeding, paving, etc.
   14. Electrical activities
   15. Heating, Ventilating, and Air Conditioning activities
   16. Plumbing activities
   17. Subcontractors' items of work
   18. Equipment/Systems Start-up and Initial Operation
   19. Final cleaning and demobilization
   20. Allowance for inclement weather and holidays
B. The CPM Schedule for the first 90 days shall be submitted within 30 days from Notice to Proceed, and the complete CPM Schedule shall be submitted within 75 days from Notice to Proceed. The Engineer and Owner will review each of these CPM schedule submissions within 14 calendar days after receipt from the General Contractor. The CPM Schedule shall be updated monthly thereafter.
C. Submit CPM schedule updates with each Application for Payment.
D. The initial 90 calendar day CPM submittal, the complete CPM Schedule, and each monthly update are conditions precedent to the monthly Application for Payment processing. Failure to submit an initial CPM Schedule, a complete CPM Schedule or an updated CPM Schedule, acceptable to the Owner and Engineer, before or with each Application for Payment will result in the Engineer not reviewing nor approving the monthly application for payment until an acceptable version of the CPM Schedule is submitted.
E. Each CPM submittal (Initial and Updates) shall include the following:
   1. Narrative Report
   2. Bar Chart (Color)
   3. Network Diagram (All activities)
   4. Disk
   5. Tabular Reports
F. Submit, with initial 90 day schedule submittal, name of organization performing the analysis. Submit the organization's qualifications for performing the CPM analysis. Include listing of at least four

projects, with a value at least equal to 50 percent of Contract Price for this Project, for which the proposed scheduling organization has performed CPM analysis. Contractor may perform the analysis if qualified. Proposed CPM scheduling organization will require approval by Engineer as a prerequisite for approval of the initial 90 day CPM schedule. Representative from the CPM scheduling organization shall examine the site in person prior to completing the initial 90 day schedule and at least once every two (2) months thereafter to verify the progress of the work.

G. Show the following items for each activity on each CPM submittal:
   1. Activity number
   2. Activity description
   3. Responsible party
   4. Original duration
   5. Remaining duration
   6. Early and late start dates
   7. Early and late finish dates
   8. Total float
   9. Percent complete

H. Sufficient care shall be exercised to produce a legible and accurate graphics (Bar charts and Network Diagrams). Activities related to a specific physical area of the project shall be grouped on the diagram for ease of understanding and simplification.

I. Exclusive of those for submittal to the Engineer for approval and material fabrication/delivery, activity durations of more than 20 working days shall be kept to a minimum. No activity duration shall be less than one working day. The "critical path" of activities shall be indicated on the Network Diagrams by a heavy or colored line and as a colored line on Bar Charts.

J. The Narrative Report shall include a description of the amount of progress during the last month in terms of completed activities in the plan currently in effect, a description of problem areas, current and anticipated delay factors and their estimated impact on performance of other activities and completion dates, and an explanation of corrective action taken or proposed.

K. The Tabular Reports should include the following sorts:
   1. Activity Number
   2. Early Start/Total Float by Area
   3. Predecessor and Successor by Activity Number
   4. Total Float
   5. Up to two (2) additional sorts as requested by the Engineer.

L. Once each month, on a date scheduled by the Engineer, a job site meeting will be held; at which time, the schedule will be reviewed. This activity may occur at a regularly scheduled Progress Meeting. The Contractor shall update the overall schedule to reflect progress to date. The updated schedule shall be available at the meeting for review.

M. All Change Orders to each Contract will be incorporated into the CPM Schedule in a manner which is consistent with the original logic of the CPM Schedule. Requested time extensions indicated on the schedule by those individual changes shall be approvable only if they impact directly on the critical sequence of the schedule. All Contract Change Orders are subject to terms and conditions of the General Conditions. Float shall be deemed to belong to the Project, and not to either the Contractor or the Owner.

N. The substantial and final completion times for construction shall be as specified in the Contract Documents. The CPM Schedule may indicate a substantial completion time prior to that time specified in the Contract Documents. Any change in the Contract times which extends a Contractor's projected substantial completion time, but does not exceed beyond the Contract substantial completion time, shall not be considered justification for additional time or monetary compensation claims by the Contractor.

O. If, in the opinion of the Engineer, any Contractor that is not prosecuting the work with such diligence as will ensure completion within the time specified, the Engineer will require the Contractor to submit a supplemental CPM Schedule. The cost associated with the submission of supplemental schedules will be paid by the Contractor. The supplemental schedule shall detail the specific operational changes to be instituted to ensure the project will be completed within the time specified. If an acceptable supplemental schedule is not received within 15 days of the date of the request, the Engineer will not review and approve the monthly application for payment.

P. When the Project is determined to be Substantially Complete, the Contractor shall submit a final record CPM Schedule incorporating the actual dates for all activities. This submittal shall be a condition precedent to requesting and receiving Final Payment.

Q. The Contractor shall provide four (4) copies to the Engineer of all CPM Schedule submissions described previously.

**1.12 DAILY LOG**

A. The Contractor shall submit weekly, to the Engineer, daily logs outlining the number of people working and their classification, major equipment, and summary of work performed.

**1.13 INSTALLATION CERTIFICATES**

A. Provide as required by individual Technical Specifications prior to testing equipment or placing equipment into service.

B. Provide the Owner with an Installation Certificate, Section 00 62 33.12, signed by the manufacturer's field representative attesting that the equipment listed below has been properly installed and is ready for testing and operation.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.1 CONTRACTOR REVIEW**

A. Review submittals prior to transmittal; determine and verify Engineer's dimensions, field measurements, field construction criteria, manufacturers' catalog numbers and conformance of submittal with requirements of Contract Documents.

B. Coordinate submittals with requirements of work and of Contract Documents.

C. Sign or initial each sheet of shop drawings and product data and each sample label to certify compliance with requirements of Contract Documents. Notify Engineer in writing, on the transmittal letter at time of submittal, of any deviations from requirements of Contract Documents.

D. Do not fabricate products or begin work which requires submittals until return of submittal with Engineer acceptance.

**3.2 SUBMITTAL REQUIREMENTS**

A. Transmit submittals in accordance with approved progress schedule.

B. Quantities: Submittal in the following quantities shall be retained by the Engineer. Contractor to determine necessary quantity to be submitted for their use:
   1. Shop Drawings: 4 prints.
   2. Product Data: 4 copies.
   3. Samples:
      a. Full Size: One.
      b. Product Variation Limitation: Samples as required to indicate variation in color, texture, pattern, or other characteristics.

C. Apply Contractor's stamp, signed or initialed, certifying Contractor's review of submittal; verification of products, field dimensions and field construction criteria; and coordination of information with requirements of work and Contract Documents.

D. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
   1. Finishes which involve Owner selection of colors, textures or patterns.
   2. Associated items which require correlation for efficient function or for installation.

**3.3 ENGINEER'S ACTION ON SHOP DRAWINGS**

A. Except for submittals for record, information or similar purposes, where action and return are required or requested, the Engineer will review each submittal, mark to indicate action taken and return.

B. Review is for general compliance with Contract Documents. No responsibility is assumed for correctness of dimensions or details.

C. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be marked, as follows, to indicate the action taken.
   1. "No Exceptions Taken": Work covered by submittals receiving this stamp may proceed provided it complies with the Contract Documents.
   2. "Make Corrections Noted – Resubmittal Not Required": Work covered by submittal receiving this stamp may proceed as noted provided the Contractor takes no exception(s) to the notation(s).
   3. "Make Corrections Noted and Resubmit": Submittal receiving this stamp must be corrected and resubmitted.
   4. "Rejected": Submittals receiving this stamp are rejected in their entirety and must be resubmitted.

D. The shop drawing submittal information must comply totally with the specifications, or else it will be stamped "Make Corrections Noted and Resubmit." The Contractor is therefore responsible for thoroughly reviewing the shop drawing information before forwarding it to the Engineer. The shop drawing information submitted must clearly indicate compliance with the specifications by enumerating the specified performance, materials of construction, protective coatings, size, etc. If compliance with the specification is not clearly defined or ambiguous, the shop drawing information will have to be resubmitted in its entirety.

E. No work may proceed unless submittals have received a stamp indicating "No Exceptions Taken" or “Make Corrections Noted – Resubmittal Not Required”.

**3.4 ENGINEER'S ACTION ON DESIGN DRAWINGS**

A. The Engineer's review will be for completeness only. Missing information will be identified in writing to the Contractor and a request for resubmittal will be made. Complete design drawing submittals will be so noted and returned to the Contractor.

B. Stamp: The Engineer will stamp the design drawing as follows:
   1. Complete: Work covered by these design drawings receiving this stamp may proceed.
   2. Incomplete Provide Missing Information and Resubmit: Design drawings receiving this stamp have missing information and must be corrected and resubmitted.

**END OF SECTION 01 30 00**

**SECTION 01 50 00**
**TEMPORARY FACILITIES**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security, and protection for this Project.
   2. Temporary construction and support facilities: Including installation, maintenance and removal are to be handled by the Contractor listed.

### 1.2 RESPONSIBILITIES

A. Refer to Part 3, Execution, for specific responsibilities.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.
B. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.
C. Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility within 15 days of the date established for commencement of the Work.

### 1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to
   1. Building code requirements.
   2. Health and safety regulations.
   3. Utility company regulations.
   4. Police, fire department and rescue squad rules.
   5. Environmental protection requirements.
B. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be inspected, tested or approved, the Contractor shall give the Engineer timely notice of its readiness and of the date arranged, so the Engineer may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, tests and approvals unless otherwise provided.
C. If, after commencement of the Work, the Engineer determines that any Work requires special testing, he will, upon written authorization from the Owner, instruct the Contractor to order such special testing. If such special testing reveals a failure of the Work to comply (1) with the requirements of the Contract Documents, or (2) with respect to the performance of the Work with laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, the Contractor shall bear all costs thereof, including Engineer's additional services made necessary by such failure.

D. Required certificates of inspection, testing or approval shall be secured by the Contractor and promptly delivered to the Engineer.

E. Neither the observations of the Engineer nor inspections, tests or approvals by persons other than the Contractor shall relieve the Contractor from his obligations to perform the Work in accordance with the Contract Documents and applicable laws and regulations of authorities having jurisdiction.

**1.5 PROJECT CONDITIONS**

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.1 ROADWAYS**

A. Existing Roadways: The Contractor shall maintain and clean, regularly, roadways, drives and parking areas within the site. Any damage caused by the use of these areas for construction purposes shall be repaired by the Contractor causing damage at their expense.

B. All construction traffic, including employee traffic, trucking, and delivery of materials and equipment, shall be controlled by the Contractor and shall enter the site only by routes identified and approved by the Owner. Access to the site by other routes will be prohibited.

C. Contractor shall take all precautions to prevent tracking of mud and debris onto the streets.

**3.2 FIELD OFFICE AND SUPPORT FACILITIES**

A. Engineer's Temporary Field Office:

1. The General Contractor shall furnish and maintain, from 5 days prior to the start of work at the project site to the date of Engineer's approval of final payment, a fully operable separate temporary field office on the construction site for the exclusive use of the Engineer; said field office and equipment shall remain the property of the Contractor. The temporary office shall be positioned on a proper foundation at a location acceptable to the Engineer with adjacent parking space for automobiles. Provide ground surface treatment to facilitate parking and access to the field office.
2. Cost of the temporary office, complete as hereinafter provided, including cost of heat, air conditioning, lighting and utilities shall be paid by the General Contractor and included in the Contract Price.
3. The temporary field office shall present a neat business-like appearance, be structurally sound and weathertight, and complete with windows with louvered blinds and security bars or grates,

toilet facilities, toilet supplies, ventilation, heating, air conditioning, overhead lighting, duplex wall outlets and telephone service; all satisfactory to the Engineer. A mobile type office will be acceptable. The field office shall be identified by a sign.

4. Size of office shall be approved by Engineer as being adequate. Minimum allowable size shall be 720 square feet.
5. The temporary field office shall be secured with lock and key, each entrance with one UL 40A:10B:C dry chemical fire extinguisher, and be complete with the following items of equipment and furniture for the exclusive use of the Engineer:
    a. 1 30"x60" Steel 2-pedestal Desk(s) w/locking drawers
    b. 1 Executive Swivel Desk Chair(s)
    c. 1 36"x60" Drafting Table(s) and Swivel Drafting Stool(s) w/backrest
    d. 1 Storage Cabinet(s) w/lock
    e. 1 Vertical Drawing File(s) w/lock
    f. 1 Vertical Plan File Rack
    g. 4 Folding Chairs
    h. 1 Refrigerator - Office Size
    i. 1 Document shredder suitable to shred CD's, staples, etc.
    j. 1 Book Case, minimum four shelves
6. Provide a containerized tap-dispense bottled water type drinking unit with instant hot water in field office; maintain adequate supply of bottles.
7. Computer Hardware: Equip the field office with one Computer system with the following minimum requirements.:
    a. INTEL, 3.0GHz CPU minimum
    b. 4GB Memory
    c. 100GB Hard Drive minimum
    d. DVD+/-RW, CDRW Drive
    e. 17" Color SVGA Monitor minimum
    f. 4 USB 2.0 Ports
    g. Network Card (10/100/1000 GB)
8. Minimum Printer Capabilities:
    a. All-In-One with printing/copying/scanning/faxing
9. Minimum Software Requirements (Must be current releases and compatible with the chosen operating system):
    a. Windows XP 32-bit operating system with Service Pack 3 minimum
    b. Microsoft Office software suite (including Word, Excel, Outlook) v2007 or higher
    c. McAfee Anti-virus/Spyware program or equal w/ update subscription thru project end-date
    d. Scansoft PDF Converter Pro, or equal
    e. WinZip
10. Minimum Networking Requirements:
    a. High-speed internet connection (DSL or Cable)
11. Minimum Computer Supplies and Accessories:
    a. America Power Company (APC) UPS model BE750BB.

b. Dust covers for computer, keyboard and printer.
c. Mouse pad
d. All consumables (recordable DVD/CD's, paper, toner cartridges)
e. Flash drive 16GB

12. Maintenance:
    a. 24 hour service or replacement for equipment that becomes unusable.
13. All furniture and equipment items shall be clean, serviceable, and satisfactory to the Engineer when installed in the field office. Maintenance service, or replacement, for equipment and furniture that become unserviceable during use shall be provided within 24 hours. The Contractor shall ensure a continuous supply of disks, copy and printer paper, ink, typewriter and printer ribbons/cartridges, etc. for the equipment.
14. The Contractor shall provide weekly janitorial service including the disposal of trash, vacuuming and/or sweeping floors, dusting tables, desks, chairs, counters, etc.
15. Failure to provide any service/supply within the time allotted will result in the Engineer securing the needed service/supply and crediting the Contractor's Contract Price.
16. An exterior temperature gauge shall be provided on the field office, and said gauge shall be used as official temperature in exterior work.
17. Equipment furnished for field office shall be returned to the Contractor at completion of project.

B. Each Contractor shall maintain a separate office for its use.

C. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
    1. The location of office and storage trailers must be submitted to the Engineer for review and approval.
    2. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

D. Provide noncombustible construction for offices, shops and sheds located within the construction area or within 30 feet of building lines. Comply with requirements of NFPA 241.

**3.3 TEMPORARY TELEPHONE**

A. Contractor shall furnish and pay for telephone service to its construction trailer.

**3.4 SANITARY PROVISIONS**

A. Contractor shall provide and maintain, in a neat and sanitary condition, suitable toilet accommodations for the use of persons on the Project.

B. Use of existing toilet facilities will not be permitted.

**3.5 TEMPORARY WATER SUPPLY**

A. The Contractor shall provide, protect and maintain non-potable water supply for construction use, if required.

B. Contractor shall provide its own source of potable drinking water.

**3.6 TEMPORARY ELECTRICAL LIGHT AND POWER**

A. Contractor shall provide all temporary electrical light and power required.
B. Contractor is responsible for electric required for its office trailers and storage containers.

**3.7 PROJECT SIGNS**

A. Project identification sign is not required for project.
B. Each Contractor shall provide temporary signs, barricades and warning lights as required to facilitate its work.

**3.8 TEMPORARY SITE DRAINAGE AND STORMWATER FACILITIES**

A. The Contractor is responsible to provide, maintain and remove all temporary facilities needed to control stormwater on the project site.

**3.9 TEMPORARY LIFTS, HOISTS, AND SCAFFOLDING**

A. Contractor shall assume responsibility for temporary hoisting equipment and materials and scaffolding required for its work. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities. Coordinate placement and use.
B. Contractor's use of the Owner's installed hoisting systems is not allowed.

**3.10 COLLECTION AND DISPOSAL OF WASTE**

A. The Contractor shall provide waste disposal services for the Project, including for hazardous or unsanitary waste materials.
B. Contractor shall collect waste from the site daily and place in the dumpster.
C. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 degrees F (27 degrees C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

**3.11 ENVIRONMENTAL PROTECTION**

A. Contractor shall provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints.

**3.12 SNOW REMOVAL**

A. The Contractor shall provide snow removal as required to facilitate access to construction and construction support areas and access to Contractor and Engineer parking areas on site.

**3.13 REMOVAL OF TEMPORARY FACILITIES**

A. Materials and facilities that constitute temporary facilities are property of the party furnishing the facility.
B. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period.
    1. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

**END OF SECTION 01 50 00**

**SECTION 01 54 00**
**BYPASS PUMPING**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc., to implement a temporary bypass pumping system for the purpose of diverting the existing sewage flow around the work area for the time that is required to install a section of pipeline.

### 1.2 QUALITY ASSURANCE

A. The design, installation and operation of the temporary bypass pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

B. The temporary primary bypass pumping system will be required to convey flows up to 1,615 GPM of wastewater if bypass pumping is to be conducted during wet weather. This pumping rate can be reduced to 6.0 MGD if the work is scheduled to occur during dry weather with no threat of rainfall to occur at least two days beyond the scheduled completion of work. If delays occur during the work, the Contractor shall be responsible for installing additional pumping capacity to accommodate the impending wet weather flow.

C. The Contractor shall include one standby pump at each pumping location. The standby pump unit shall be piped into the inflow and to the bypass piping so that, upon starting the engine or motor, the standby pump will pick up the flow.

D. The Contractor shall provide necessary sound abatement to meet a 70 dB sound level.

### 1.3 JOB CONDITIONS

A. The Contractor will provide all necessary means to safely convey the normal flows past the work area. The Contractor will not be permitted to stop or impede the main or any sideline flows under any circumstances.

B. The Contractor must give written notice of utility interruption as per Section 01 00 00.

### 1.4 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. The Contractor shall prepare a specific detailed description of the proposed bypass pumping system; the submittal shall include a written description of the plan and shall address the quantity, capacity, and location of all pumping equipment. All pumping equipment submitted shall include the pump's performance curves. The size, type and routing of all suction and discharge pipes and the means of connecting the system shall also be included. This information shall be submitted to the Engineer for review; no bypass pumping shall take place until reviewed by the Engineer.

### 1.5 SPECIAL PRECAUTIONS

A. If any surface spills of raw wastewater occur due to the failure of the Contractor to maintain the temporary pumping when needed. The Contractor shall be responsible for any fines levied on the Owner by the state, federal or any other applicable agency.

B. The Contractor shall be solely responsible for and libel for any basement flooding caused by a failure to perform this function properly.
C. Place all pumping equipment, fuel tanks and accessories in containment facilities to prevent the leakage of sewage, oil, fuel, grease, etc. onto the ground. Remove and properly dispose of spilled material routinely from the containment facility to prevent an overflow.

**PART 2 PRODUCTS**

**2.1 PUMPS**

A. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the specified flow range without surging, cavitation, or vibration. The pump shall not overload the driver at any point on the pump operating curve. The pump shall be suitable for use with raw unscreened sewage and trash. The pump shall be a self-contained unit, designed for temporary use.
B. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system or they can be submersible pumps. The pumps shall be diesel or electrically powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.
C. Pumps that are engine driven shall be on skid bases with a centralized lifting bracket and integral fuel tank. The pump shall be direct coupled to an electric start diesel engine. Provide an integral belt driven compressor to operate the air ejector priming system. Submersible pumps shall be powered by an electric generator.
D. Contractor shall provide the necessary start/stop controls for each pump.

**2.2 PIPING**

A. In order to prevent the accidental spillage of flows, all discharge system must be constructed of either sound hose or rigid pipe with positive, leak-proof connections.
B. Pipe 12 inches and larger shall be high density polyethylene pipe with fused joints for a leak-proof piping system.

**2.3 TEMPORARY PLUGS**

A. Plugs shall be inflatable plugs constructed of specially treated industrial fabric and reinforced neoprene. Plugs shall be equipped with steel pull rings and aluminum end clamps.
B. All plugs shall be firmly attached to a stationary object at ground level by a steel cable in order to prevent loss of plug in the pipeline.

**PART 3 EXECUTION**

**3.1 TEMPORARY INSTALLATION**

A. Installation shall include furnishing oil, fuel, grease, lubricants, tools and spare parts that may be required to maintain the operation of the pump throughout the construction period, as recommended by the manufacturer. The Contractor shall be solely responsible for maintaining the temporary bypass pumps and appurtenances. At the end of the construction period, the Contractor shall remove the pump and appurtenances.
B. The pumps shall be installed for temporary use only. The Contractor shall be responsible for proper operation of the complete pumping system, which includes pump, driver, controls and appropriate pipe

connections, during the construction period.

C. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

D. The Contractor shall insure that the temporary bypass pumping system is properly maintained and a responsible operator shall be on hand at all times when pumps are operating.

E. The temporary pumping system shall be placed in service a minimum of 24 hours before any work may begin. It shall remain operable for at least 72 hours after the repairs are completed and its removal is approved by the Owner in writing.

F. Once written permission is issued, the Contractor shall remove all components of the temporary pumping system. The Contractor shall perform all restoration work to the satisfaction of the Owner.

**END OF SECTION 01 54 00**

**SECTION 01 60 00**
**MATERIAL AND EQUIPMENT**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Products.
   2. Substitutions.
   3. Transportation and Handling.
   4. Storage and Protection.
   5. Testing of Equipment.

### 1.2 PRODUCTS (STANDARD OF QUALITY)

A. Products include material, equipment, and systems.
B. Comply with Specifications and referenced standards as minimum requirements.
C. The materials, articles, devices, products, fixtures, form or type of construction in these Specifications are specified by trade name, manufacturer's name, catalog reference or by description, to establish the standard of quality and design desired, and shall not be interpreted as limiting competition.
D. Design, arrangement, details, utility requirements and dimensions shown on Drawings and included in Schedules and Specifications have been determined and established, after considerable study and planning, based on the criteria of the first named manufacturer. Other manufacturers named or substitutes are considered to be able to perform the same function but not necessarily have same design, arrangement, details, utility requirements and dimensions. Therefore, if a Contractor desires to use a manufacturer or product other than first named, he shall assume the responsibility of coordination and all costs or extra charges, including costs in connection with Work of other trades or separate Contracts, necessitated by their use.
E. Colors: Where indicated or specified as “color to be selected” or “color selected by the Engineer”, the color will be selected from the full range of all available colors of the first named manufacturer or an equivalent color of other manufacturers.
   1. Color selections: Color selections where applicable, will be made after ALL product samples are submitted and approved.

### 1.3 SUBSTITUTIONS AFTER BIDDING

A. Substitution of Materials and Equipment After Execution of Contract: Materials and equipment of makes other than those specifically named in Contract Documents will be considered by Engineer and Owner.
B. Any requests for substitution after execution of Contract shall be accompanied by documentary proof of equality, delivery dates and price comparison in form of certified quotations from suppliers of both specified and proposed equipment.
C. Processing Substitutions After the Award of the Contract:
   1. The Contractor shall submit the request for substitution to the Engineer including the following:
      a. Documentary proof of equality.

b. Specifications for both the specified product and proposed substitution including a comparison chart of attributes.
c. Delivery dates.
d. Price comparison in form of certified quotations from suppliers of both specified and proposed equipment.
e. Credit to be given to the Owner.

2. Substitution will be reviewed by the Engineer only at the written request of the Owner. The Owner will include any expenses in connection with the review of the proposed substitution as part of the credit to be given to the Owner, including the reimbursement of the Engineer's time for review.

**1.4 ADDITIONAL COSTS RESULTING FROM SUBSTITUTE MATERIAL OR EQUIPMENT**

A. The Contractor shall comply with the General Conditions regarding substitute material or equipment. Additional costs resulting from installation of approved substitute material or equipment including alterations in connecting piping or conduit, changes or alteration to foundations, anchor bolts, control systems, or other additional costs attributed to use of the substitute material or equipment shall be the sole responsibility of the Contractor.

**1.5 TRANSPORTATION AND HANDLING**

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

**1.6 STORAGE AND PROTECTION**

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
B. For exterior storage of fabricated products, place on sloped supports aboveground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

**1.7 EQUIPMENT STORAGE**

A. The Contractor is required to provide a covered storage area for equipment delivered to the site. Electrical and instrumentation equipment shall be stored in a closed, conditioned storage area. All equipment delivered and stored on the project site shall be in strict accordance with the equipment supplier's storage procedures.
B. The Contractor shall submit along with the shop drawing submittal for each piece of equipment the equipment manufacturer's recommended short term and long term storage maintenance procedures.

These procedures are to be implemented fully by the Contractor. Using the information submitted by the manufacturer, the Contractor shall prepare and submit for approval a schedule listing maintenance tasks and schedule dates for each task for each piece of equipment. The Owner's Representative will verify that the recommended procedures are being performed, and he along with the Contractor's representative will initial a log sheet when the maintenance task is completed. These storage maintenance procedures shall be performed from the time the equipment arrives on site until the equipment is placed into operation.

C. Motors with condensate heaters delivered to the site which are not installed within 30 days or motors installed but not operational within 30 days shall be wired to provide full operational use of the condensate heaters.

D. Lubricant drain piping, valves, end plugs and associated components required for servicing equipment including lubricants for storage, start-up and normal operation and desiccant bags for moisture protection of motors, actuators and panels shall be furnished by the Contractor.

**1.8 TESTING OF EQUIPMENT**

A. After Engineer for proper testing and instruction of operating personnel.

B. Fuel, electricity and water, required for proper testing of permanent equipment and for the period of instructing personnel, shall be supplied by the Contractor performing the test or instruction.

**1.9 START-UP AND PERFORMANCE TESTING**

A. All utilities, supplies and materials required in connection with start-up and performance testing shall be provided and paid for by the Contractor. Laboratory testing services will be performed by a testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

B. The Contractor is responsible to fill tanks, sumps, and pits with clean water as required to fulfill performance testing requirements for pumps, aerators, mixers, blowers, etc.

**1.10 VIBRATION AND INFRARED TESTING**

A. Vibration and infrared testing shall be performed by an independent testing agency engaged and paid for by the Contractor and approved by the Engineer. The Contractor will be responsible for the vibration testing and infrared testing for that equipment provided under this Contract. All costs for the initial testing and re-testing (if required) shall be included in the lump sum price for this Contract. Acceptable testing limits will be the limits submitted as part of the shop drawing submittal by the equipment suppliers. Testing limits which are submitted and do not meet the minimum standard of the industry for that piece of equipment will not be accepted, and the standard of the industry will be used as the allowable limit for testing. The Contractor providing the equipment shall assume all costs in the event that the equipment fails to meet the requirements of the test. These costs include costs for additional vibration testing, additional infrared analysis, and additional utilities, etc., for test reruns when such test reruns were caused by faults properly the responsibility of the Contractor. The Contractor will provide the Owner with all test data in report form. If equipment fails the vibration or infrared analysis, the Contractor will, within three weeks from the initial test date, perform the required corrective measures and/or provide evidence of substantial effort to bring the

equipment within acceptable testing limits.

B. All vibration and infrared testing will be performed in the field at the job site. Items for vibration testing should include all drive motors and drive shafts. Tests should be done when the equipment is installed and operating under load. Test points should include all support points and shaft axial end points.

C. Perform an infrared scan test on all electrical connections to control panels, junction boxes, motors, and electrical components furnished under the Contract. Furnish a thermograph (infrared photo) to the Engineer of all problem areas with the temperature rise and location noted.

1. Panelboards
2. Motor Control Centers
3. Control Panels
4. Equipment Connections (Including Motors)
5. Substation Breakers - New and existing that are modified.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION 01 60 00**

**SECTION 01 70 00**
**PROJECT CLOSEOUT**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
   1. Inspection procedures.
   2. Project record document submittals.
   3. Operating and maintenance manual submittal.
   4. Release of liens.
   5. Submittal of warranties.
   6. Final cleaning.

### 1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Conduct cleaning and disposal operation to comply with codes, ordinances, regulation, and anti-pollution laws.

### 1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documents for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
   2. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
   3. Advise the Owner of pending insurance change-over requirements.
   4. Submit to the Engineer specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
   5. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities.
   6. Submit to the Engineer record drawings, maintenance manuals, and similar final record information.
   7. Deliver spare parts, extra stock, and similar items to the Owner via the Engineer.
   8. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change-over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
   9. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractors of unfilled requirements. The Engineer will prepare the

Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat inspection (limit one time) when requested and assured that the Work has been substantially completed.
2. Results of the completed inspection will form the basis of requirements for final acceptance.

**1.4 FINAL ACCEPTANCE**

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
   1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
   3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.
   4. Submit consent of surety to final payment.

B. Reinspection Procedure: The Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.
   1. Upon completion of reinspection, the Engineer will certify the final Application for Payment or advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
   2. If necessary, reinspection will be repeated.
   3. If more than one inspection for final completion is required, the Prime Contractor will be billed for the time and expenses.

**1.5 RECORD DRAWINGS**

A. The Contractor is required to keep an up-to-date set of Record Drawings (As-Constructed Drawings) for the project.

B. In addition, the General Contractor shall identify the location of all new piping installed, existing piping to remain and existing piping to be abandoned as it is installed or uncovered during the construction period. No trenching for piping shall be backfilled until the piping has been located by the General Contractor.

C. The Contractor shall identify the location of all buried or embedded conduits and duct banks including new work and existing to remain or to be abandoned as it is installed or uncovered during the construction.

D. Up-to-date is defined as containing modifications for work performed within the past 30 days. The record drawing information shall include but not be limited to the following:
   1. All dimensional changes. Degree of dimensioning shall equal that of the original drawing except for yard piping and site electrical drawings.

a. The Record Drawing dimensioning for the yard piping and site electrical (buried or embedded conduits and duct banks) drawings shall include as a minimum both horizontal locational dimensioning from above grade permanent structure and elevation at each location where the process piping or electrical work enters or leaves a structure and at each change in direction. In addition, where the buried process piping or electrical work parallels the wall of a structure, horizontal dimension from the structure and elevation shall be provided at a minimum of two locations.

2. All pipe inverts and tip of frame elevations for gravity pipelines.
3. Electrical breaker designations for each circuit such as receptacles, lights, heaters, etc.
4. All internal piping valve and fitting modifications. Degree of detail shall be equal to that of the original drawing.
5. All structural reinforcement modifications.
6. All electrical conduit size and routing wire size and wiring quantity modifications, wiring number and tagging assignments.
7. All site work modifications such as roadways, sidewalks, grading, etc.

E. The Engineer will review the status of the Contractor's record drawings on a monthly basis. If the record drawings do not meet the requirements stated above, 10 percent of the succeeding progress payments, in addition to the normal contract retainage, will be withheld until such time as the record drawings are brought into compliance.

F. The Contractor shall make the record drawings available to the Engineer whenever requested for reproduction by the Engineer so that he can begin preparation of the final record drawings to be supplied to the Owner.

G. At the end of the project, the Contractor's record drawing set shall be turned over to the Engineer.

**1.6 GUARANTEES, CERTIFICATES, AND OPERATION AND MAINTENANCE MANUALS**

A. During the course of the Work and within six weeks after approval of Shop Drawings, Contractor shall collect and assemble three copies each of the guarantees, manufacturers' specifications sheets and/or working drawings, operation and maintenance instructions, parts lists including exploded views, recommended safety procedures, and recommended list of spare parts. The Contractor shall submit all copies, with an itemized listing, to the Engineer.

B. Operation and Maintenance Manuals shall include all mechanical and electrical equipment specified in Division 01 through 44 including heating, ventilation, air conditioning and lighting equipment.

C. Furnish Operation and Maintenance Manuals on 8-1/2" x 11" sheets or booklets, loose bound in 3-ring binders with front and back page lifters, with binder contents indicated on the front and spine of the binder cover. All loose sheets shall be in vinyl page protectors with reinforced binding edge. Furnish drawings included in the manuals on 11" x 17" sheets laminated and folded to 8-1/2" x 11" or folded and placed in vinyl "envelope pockets" incorporated into the binder. All materials in manuals shall be original print quality manufacturer's literature. Photostatic copies of printed materials are not acceptable. Provide an index of the contents of each manual or a master index for a system consisting of several manuals. Provide printed and laminated, reinforced index tabs for each manual. Indexed

sections to include Installation, Start-up, Operation, Troubleshooting, Maintenance, Parts List, Recommended Spare Parts and Miscellaneous Components.

D. Include a detailed description of function of each principal component, procedures for starting, operation, overhaul and maintenance. Include safety precautions, test procedures and a catalog cross-reference to commercially available parts.

E. Submit a Preventive Maintenance and Lubrication Schedule for the equipment furnished which specifically explains the duties to be fulfilled by the Owner during the guarantee period. List the manufacturer's recommended lubricant plus two equal substitutes for all equipment.

**1.7 RELEASE OF LIENS**

A. The Contractor shall deliver to the Engineer a blanket release of liens covering all Work performed under this Contract, including that of subcontractors, sub-subcontractors, vendors, and other suppliers of materials and labor. Execute the release of liens on documents provided by the Engineer similar to AIA Document G706, "Contractor's Affidavit of Payment of Debtors and Claims", and AIA Document G706A, "Contractor's Affidavit of Release of Liens".

B. The forms shall be executed by the authorized officer and notarized. All required attachments shall be included as noted on AIA Document G706. If exceptions are listed in either AIA Document G706 or Document G706A, the Contractor shall furnish bond satisfactory to the Owner for each exception.

**1.8 PROJECT CLOSEOUT SUBMITTALS**

A. Submit two copies of Project Closeout submittals bound in three-ring binders, clearly labeled to the type of submittal. Provide pocket folders for folded information.

B. Submittals shall be submitted within ten days of Substantial Completion and prior to final Application for Payment.

C. Warranties and Bonds:

1. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers.
2. The beginning date of all warranties shall be the date of Substantial Completion.
3. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual; identify the number and title of the Specification Section in which product is specified. Separate each warranty or bond with index tab sheets keyed to Table of Contents. List subcontractor, supplier, and manufacturer, with name, address and telephone number of responsible principal.

**PART 2 PRODUCTS**

**2.1 CLEANING MATERIALS**

A. Use only those materials which will not create hazards to health or property, and which will not damage finishes and surfaces.

B. Use only materials and methods recommended by manufacturer of material being cleaned.

**PART 3 EXECUTION**

**3.1 CLOSEOUT PROCEDURES**

A. Operating and Maintenance Instructions: Each installer of equipment that requires regular maintenance shall arrange to meet with the Owner's personnel to provide instruction in proper

operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items.

1. Operation and maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

**3.2 INITIAL OPERATION**

A. The Contractor shall place the completed Project, equipment and systems into initial operation. The schedule and sequence of the initial operation procedures shall be included in the Project CPM Schedule. Coordinate the initial operation procedures with other contractors and the Owner's operating personnel.

**3.3 FINAL CLEANING**

A. All final cleaning shall be performed by the Contractor, unless otherwise specified.
B. Remove temporary protection and labels not required to remain.
C. Clean surfaces free of grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
D. Clean transparent glossy materials to a polished condition; remove foreign substances. Polish reflective surfaces to a clear shine.
E. Vacuum clean carpeted and similar soft surfaces as specified.
F. Clean, wax, and polish resilient and hard-surfaced floor as specified.
G. Clean surfaces of equipment; remove excess lubrication.
H. Clean plumbing fixtures, food service equipment, hospital equipment, and similar equipment to a sanitary condition.
I. Electrical Devices and Lighting:

1. Clean light fixtures, lamps and lenses.

2. Clean the faces of all electrical devices and cover plates for same, including power receptacles, switches, computer outlets, computer and TV outlets, TV outlets, telephones, communication speakers, fire alarm speakers, fire alarm pull stations, fire alarm flashing lights, smoke detectors, clocks, speaker volume control switches, security system motion detectors, and fire alarm horns.
3. Clean the fronts of all electrical panelboards and the main distribution switchboard.

J. Remove waste, debris, and surplus materials from site. Clean grounds; remove stains, spills, and foreign substances from paved areas and sweep. Rake clean other exterior surfaces.

**3.4 WARRANTY INSPECTION**

A. Two months prior to expiration of the one year guarantee period, the Contractor shall make an inspection of the work in the company of the Engineer and the Owner. The Engineer and the Owner shall be given not less than five days' notice prior to the anticipated date of warranty inspection.

B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Engineer and the Owner, even though the date of completion of the corrective work may extend beyond the expiration date of the guarantee period.

C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

**END OF SECTION 01 70 00**

**SECTION 02 41 13**
**SITE DEMOLITION**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Work included:
   1. relocation of selected equipment necessary for installation of new equipment.
   2. Items shall become the property of Contractor and be removed; equipment and materials shall be legally disposed of off-site by Contractor.
   3. Take all necessary precautions to insure against damage to existing work to remain in place and any damage to such work shall be repaired or replaced as approved at no additional cost to the Owner.

### 1.2 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.
B. Obtain, pay for, and submit all permits required for execution of demolition work including the following:
   1. Certificates of severance of utility services.
   2. Permit for transport and disposal of debris.
   3. Demolition procedures and operation sequence.
C. Submit demolition procedures and operation sequence.
D. Permits for Disposal of Debris:
   1. Arrange for legal disposal of debris and obtain written agreements with the owners of the property where the debris shall be deposited.
   2. Provide a certification of disposal (use form attached at the end of this section) that an agreement releasing the Owner from all responsibility in connection with the disposal of the debris was executed.

### 1.3 COORDINATION

A. Utility Removal: Arrange with utility companies for changes in their equipment, and capping of pipes and wiring as required.
B. Schedule disruption of utilities or facilities with the Owner a minimum of 48 hours in advance of shut-down.
C. Maintaining Traffic:
   1. Do not close or obstruct public streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
   2. If required by authorities, provide alternate routes around closed or obstructed traffic ways.

### 1.4 JOB CONDITIONS

A. Existing Conditions: Survey existing work and examine the Contract Documents to determine extent of demolition work.
B. Protection:
   1. Includes but not limited to erecting barriers, dust partitions, fences, guard rails, enclosures, chutes and shoring as required to protect structures and utilities remaining intact.

2. Protect any trees, plants, grass and other landscaping designated to remain from damage. Replace any trees, plants or other landscaping materials designated to remain that are damaged during the work under this Contract.
3. Protect the interior of the building and all materials and equipment from the weather at all times. Replace materials and equipment damaged by weather at no additional cost to the Owner.
4. Control activities to prevent the spread of dust and avoid nuisance in surrounding areas.
5. Take necessary precautions to insure against damage to existing materials or equipment to remain in place. Repair or replace damaged materials and equipment at no additional cost to the Owner.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.1 PREPARATION**

A. Preparation:
1. Verify the extent of demolition work to be performed with the Engineer.
2. Verify that structures, equipment or spaces to be demolished are isolated, unoccupied and discontinued in use.
3. Arrange for and verify termination of utility services, including removing meters and capping lines.

**3.2 DEMOLITION**

A. Demolition:
1. Demolish structures in accordance with demolition procedures submitted.
2. Maintain area outside in as clean condition as possible during progress of demolition work.
3. Care shall be taken in partial removal of existing masonry or stonework, where new work shall be tied-in to achieve "tooth-effect", by removal of each whole unit along its horizontal and vertical mortar joints.
4. Remove masonry necessary for required opening.
5. Make straight-sided rectangular openings, with masonry power saw, only where authorized.
6. Existing utilities shall be removed as indicated; when utility lines are encountered that are not indicated on the Contract Drawings, the Owner and Engineer shall be notified.
7. Use of explosives will not be permitted.
8. Limit dust to lowest practicable level.
9. Repair damage to adjacent construction or structures.
10. Remove all clamps, brackets, supports, hangers, conduits, controls, wire, equipment pads, etc. associated with equipment/pipe indicated to be removed and patch all areas to match adjacent areas.

B. Owner has the right to salvage any materials or equipment.

**3.3 DISPOSAL**

A. Disposal:
1. Remove demolition debris to designated disposal area promptly.
2. Do not store or burn materials on-site.

3. Disposal areas shall be approved by Department of Environmental Protection and any other authorities having jurisdiction.

**CERTIFICATE OF DISPOSAL**

The undersigned hereby attests that they have written agreements to dispose from the Smithsburg WWTP ENR Upgrade and Expansion Project, Washington County, Maryland and hereby certifies that all disposal of debris is in accordance with all Federal, State and local laws and regulations.

Approximate Quantity of Material Disposed: _____ Cubic Yards

Type of Material Disposed: _____

_____

Location of Disposal Site: _____

_____

Contractors: _____

_____

President (Signature)

_____

(Typed/Printed Name)

_____

Treasurer (Signature)

_____

(Typed/Printed Name)

(Corporate Seal)

Attest: _____

Secretary (Signature)

_____

(Typed/Printed Name)

**END OF SECTION 02 41 13**

**SECTION 03 30 00**
**CAST-IN-PLACE CONCRETE**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:
   1. Concrete Reinforcement
   2. Concrete Formwork
   3. Cast-In-Place Concrete
   4. Concreting Accessories

B. Related Work Specified Elsewhere:
   1. Section 03 60 00 - Grout
   2. Section 07 13 00 - Sheet Waterproofing

### 1.2 REFERENCED STANDARDS AND SPECIFICATIONS

A. American Concrete Institute (ACI):
   1. 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
   2. 305R Hot Weather Concreting
   3. 306R Cold Weather Concreting
   4. 309 Recommended Practice for Consolidation of Concrete
   5. 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
   6. 318 Building Code Requirements for Reinforced Concrete
   7. 347 Recommended Practice for Concrete Formwork
   8. 350R Concrete Sanitary Engineering Structures

B. American Society for Testing and Materials (ASTM):
   1. A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
   2. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. A706 Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcements
   4. C31 Making and Curing Concrete Test Specimens in the Field
   5. C33 Specifications for Concrete Aggregate
   6. C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
   7. C88 Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   8. C94 Specification for Ready-Mixed Concrete
   9. C143 Test for Slump of Portland Cement Concrete
   10. C150 Specification for Portland Cement
   11. C171 Specification for Sheet Materials for Curing Concrete
   12. C172 Sampling Fresh Concrete
   13. C173 Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
   14. C231 Test for Air Content of Freshly Mixed Concrete by the Pressure Method

15. C260 Specification for Air-Entraining Admixtures for Concrete
16. C272 Test Method for Water Absorption of Core Materials for Sandwich Construction
17. C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
18. C494 Specification for Chemical Admixtures for Concrete
19. C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
20. C535 Test for Resistance to Abrasion of Large Size Coarse Aggregate by the Use of the Los Angeles Machine
21. C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation
22. C920 Specification for Elastomeric Joint Sealants
23. D1751 Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
24. D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
25. D1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Construction

C. American Welding Society (AWS):
1. D12.1 Welding Reinforcing Steel Metal Inserts and Connections in Reinforced Concrete Construction

**1.3 QUALITY ASSURANCE**

A. Design Criteria:
1. Design each required concrete group to meet the physical properties specified in Table I of this Section.
2. In addition to structural strength and stability requirements, design and construct concrete in structures built with Concrete Groups D, E, F, and G to ensure:
   a. Maximum density and impermeability - these qualities are achieved with low water cement ratios and a slow, moist cure.
   b. Maximum resistance to reaction of chemicals, alternate wetting and drying, and exposure to the elements.
   c. Well-formed and smooth surfaces to minimize resistance to flow.

B. Testing Agency: Concrete testing for slump, compressive strength, and air content shall be performed by a testing laboratory engaged and paid by the Contractor and approved by the Engineer. No concrete shall be poured unless the testing agency is on-site.

C. Concrete Testing:
1. Perform compressive strength, slump, and air content tests for each 50 cubic yards of concrete placed, or any portion thereof, for each structure. Cast at least 5 cylindrical strength test specimens for each batch. Test 2 cylinders at 7 days; test 2 cylinders at 28 days. Hold the remaining cylinder for testing in the event that any of the other cylinders are damaged prior to testing. Test concrete from Groups C and F of Table I at 3 days rather than at 7 days.
2. Determine concrete strength from standard test specimens made and cured according to ASTM C31 and ASTM C172, and tested in accordance with ASTM C39. Perform core drilling and testing in accordance with ASTM C42. Compute and evaluate in accordance with ASTM C94.

3. Determine air content in accordance with ASTM C231 or ASTM C173, as applicable.
4. Determine slump in accordance with ASTM C143.
5. Keep a slump cone and an air meter in close proximity to all concrete placements.
6. Testing is not required for non-structural applications such as equipment base pads, sidewalks, and other such uses.

**1.4 SUBMITTALS**

A. General: Submit in accordance with Section 30 00.

B. Shop Drawings: Submit detailed reinforcing drawings prepared in accordance with ACI 315, including bar schedule with bar marks and bends indicated.

C. Design Mix:
1. Prior to start of placing concrete, submit design mix for each group of concrete, indicating that the concrete ingredients and proportions will result in a concrete mix meeting the physical requirements for each concrete group specified in Table II of this Section.
2. Do not vary the proportions of the ingredients or source of material of the approved mix without submitting corresponding test result documentation to the Engineer for approval.

D. Manufacturer's Literature: Submit manufacturer's product literature including catalog information, dimensions, materials, instructions for installation and use, and application rates for:
1. Waterstop
2. Premolded Expansion Joint Filler
3. Membrane Curing Compound
4. Cementitious Materials
5. Admixtures
6. Floor and Slab Treatments
7. Vapor Retarders
8. Repair Materials

E. Certificates:
1. Submit a certification attesting that reinforcing steel meets the requirements of ASTM A615 including Supplementary Requirement S1, and that welded steel wire fabric meets the requirements of ASTM A185.
2. Submit, with the concrete mix design, laboratory test reports and manufacturer's certificates attesting the conformance of ingredients with these specifications (ASTM C94, paragraph 5.3.2).
3. Submit a certification or delivery ticket from the concrete supplier for each batch delivered to the site (ASTM C94, Section 15). The delivery ticket shall list: name of ready-mix batch plant, serial number of ticket, date and truck number, name of contractor, specific designation of job, batch number, amount of concrete, time loaded or of first mixing of cement and aggregates, number of revolutions, water added by receiver of concrete and his initials, type and name of admixtures and amount of same, type and brand of cement, amount of cement, total water content by producer, maximum size of aggregate, weights of fine and coarse aggregate, and indication that ingredients are as previously certified or approved.

F. Test Reports: Submit four copies of required slump tests, air content tests, and strength tests.

G. Pour Schedules: Submit concurrently with the steel reinforcing drawings six copies of concrete pour schedules showing sequence of pours and all contraction, expansion and construction joints.

**1.5 PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Reinforcing Steel:
   1. For reinforcing steel fabricated on-site, ship from the mill in bundles, limited to one size and length, tagged with a waterproof tag showing the name of the mill, heat number, grade and size of the bars, and identifying number.
   2. For reinforcing steel fabricated off-site, deliver in bundles identified as to structure and shop drawing number. Identify each individual bar with a waterproof tag showing the grade, size and bar mark from the approved bar schedule.
   3. Protect reinforcing steel and wire fabric from damage and from dirt, oil, grease, other foreign matter, and rust-causing conditions. Do not store reinforcement in direct contact with the ground.

B. Concrete Ingredients: Handle, control and store concrete materials in accordance with ACI 304, Chapter 2.

**PART 2 PRODUCTS**

**2.1 READY-MIX CONCRETE**

A. Shall conform to ASTM C94, except as noted otherwise.

B. Materials:
   1. Cement: ASTM C150, Types II, IIA, III, and IIIA as indicated in Table I.
   2. Fine Aggregate: ASTM C33, with the following additional requirements for Concrete Groups D, E, F, and G only:
      a. Washed natural sand.
      b. Weighted percentage of loss not more than 12 percent by weight when subjected to five cycles of the magnesium sulfate soundness test in accordance with ASTM C88.
      c. Coarse Aggregate: ASTM C33, with the following additional requirements for Concrete Groups D, E, F, and G only.
         1) Percentage of wear not exceeding 45 percent when tested in accordance with ASTM C535.
         2) Weighted percentage of loss not more than 15 percent by weight when subjected to five cycles of the magnesium sulfate soundness test in accordance with ASTM C88.
      d. Water: Potable
      e. Admixtures:
         1) Air Entraining Admixture: ASTM C260.
         2) Admixtures containing calcium chloride or soluble chlorides shall not be used in concrete:
            (a) containing aluminum,
            (b) subject to alkali-aggregate reaction, and
            (c) for Concrete Groups D, E, F, and G of Table I.
            (d) Admixtures other than air entraining shall conform to ASTM C494.
            (e) All admixtures are subject to the written approval of the Engineer.
         3) Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.1 percent chloride ions

4) High Range Water Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G and containing not more than 0.1 percent chloride ions.
5) Water-Reducing, Non Chloride Accelerator Admixture: ASTM C494, Type E, and containing not more than 0.1 percent chloride ions.
6) Water Reducing, Retarding Admixture: ASTM C494, Type D, and containing not more than 0.1 percent chloride ions.

C. Mix Proportioning:
1. Select proportions for concrete to obtain the quality requirements for each group of concrete as specified in Table I of this Section.
2. Where Concrete Group A is specified, Group C may be used upon written approval of the Engineer. Where Concrete Group D is specified, Group F may be used upon written approval of the Engineer.

D. Failure to Meet Strength Requirements: Paragraph 17 of ASTM C94 shall not apply. Failure to meet strength requirements will be governed by the appropriate provisions of the General Conditions.

**2.2 REINFORCEMENT**

A. Reinforcing Steel Bars: ASTM A615 including Supplementary Requirement S1, Grade 60. For applications requiring welding of reinforcing steel bars, use ASTM A706, Grade 60, Low-Alloy Deformed Bars (except where smooth bars are indicated).
B. Welded Steel Wire Fabric: ASTM A185

**2.3 CONCRETING ACCESSORIES**

A. Premolded Expansion Joint Filler: ASTM D1752
1. Sponge Rubber: Type I
2. Cork: Type II
3. Self-Expanding Cork: Type III

B. Premolded Expansion Material for Sidewalks: ASTM D1751 with polyurethane joint filler, single component sealant in accordance with ASTM C920.
C. Waterstops.
1. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets for proper positioning of waterstop in forms at time of concrete placement, and for embedding in concrete to prevent passage of fluids through joints. The waterstops shall be wired to the reinforcement in accordance to the manufacturers recommendations. If no manufacturer recommendations are available then the waterstop shall be wired a maximum of four (4) feet on center. The waterstop shall be installed with factory fabricated corners, intersections, and directional changes. Provide at all construction, contraction and expansion joints and at other joints as indicated on the Contract Drawings.
a. Available Manufactures:
1) Bometals, Inc.
2) Greenstreak.
3) W. R. Meadows, Inc.
4) Paul Murphy Plastics Co.
5) Progress Unlimited, Inc.

6) Or equal.

b. Profile: Ribbed with center bulb, as indicated.

c. Dimensions: 9 inches by 3/8 inch minimum thickness, unless noted otherwise.

2. Retrofit water stop: Polyvinyl Chloride water stop with stainless steel batten bars and stainless steel fasteners for anchoring to the existing structure with the aid of an epoxy gel having 7/16 inch minimum thickness. Retrofit water stop shall be:

a. Sika Greenstreak:

b. JP Specialties, Inc.

c. Or equal.

3. 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.

a. Available Products:

1) Deneef Construction Chemicals; Swellseal.

2) Greenstreak; Hydrotite.

3) Mitsubishi International Corporation; Adeka Ultra Seal.

4) Progress Unlimited, Inc.; Superstop.

5) Or equal.

D. Waterstops at joints between new and old concrete or where indicated on the Contract Drawings:

1. Specially formulated joint sealant comprised of bentonite/butyl rubber supplied in coil forms.
2. Upon hydration the water stops shall swell to form a self-healing compression seal that completely locks out water and prevents water migration along the waterstop.
3. Install a minimum of two inches from edge of wall joint. Install two parallel strips of waterstop at each wall joint. Install two parallel strips of waterstop at each wall joint.
4. Installation shall be in strict conformance with manufacturer's requirements.
5. Waterstops shall be Adeka ULTRA SEAL.

E. Vapor Barrier Basis of Design Manufacturer: Stego Industries; www.stegoindustires.com.

1. Product: Stego Wrap Vapor Barrier - 15mil.
2. Accessories: Stego Claw joint tape, 3 inches wide, 26 mil thickness.
3. Installation: Coordinate with cast-in-place concrete placement and install per manufacturers requirements.

F. Sealant: Polysulfide base, synthetic rubber sealant, non-staining, non-sag.

1. Two-component: ASTM C920, Type M, Grade NS
2. One Component: ASTM C920, Type S, Grade NS

G. Membrane-Forming Curing Compound: ASTM C309, Type 1D (100 resin) with fugitive dye and Type 2, Class B.

1. Apply by spraying.
2. Application Rate: As recommended by the manufacturer.
3. Use Type 2 when curing temperature is expected to be greater than 80 degrees F, during the first 3 days of curing.
4. Use either all Type 1 or all Type 2 for an entire structure.

H. Bond Breaker: Non-staining liquid product which imparts a waterproof film to prevent adhesion of concrete and will not leave a paint-impeding coating on the face of the concrete.

I. Waterproof Sheet Material for Curing: ASTM C171.

J. Spacers, Chairs, Bolsters, Ties and Other Devices:
   1. Galvanized steel or non-corroding material conforming to the requirements of the Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice for Reinforced Concrete Construction".
   2. Form ties used in the construction of liquid containment structures shall have integral waterstops in accordance with ACI 350R. The ends of the tie metal, after breaking, should be at least 1-1/2 inches from the face of the concrete wall.

K. Perimeter Insulation:
   1. Shall be extruded polystyrene foam insulation; square edges; 2 inches thick by 24 inches wide by length required.
   2. The R value shall be 5.0 per inch of thickness (5-year aged value), ASTM C518.
   3. Water absorption shall not exceed 0.1 percent by volume, in accordance with ASTM C272.
   4. Compressive strength of 25 pounds per square inch minimum according to ASTM D1621.
   5. Comply with ASTM C578, Type IV.
   6. Shall be as manufactured by Dow Chemical, Owens-Corning, or equal.

## PART 3 EXECUTION

### 3.1 GENERAL

A. Unless otherwise specified, conform to ACI 304, 305R, and 306R for concrete installation requirements such as preparation, mixing, conveying, depositing, curing, and cold and hot weather requirements. Consolidate concrete in accordance with ACI 309.

B. Concrete not placed within 90 minutes or 300 revolutions, whichever occurs first, after the first mixing of the cement and aggregates will be rejected.

### 3.2 COORDINATION

A. Examine the drawings and specifications for work of other sections or other contractors and coordinate such work with the requirements of this Section. Make provisions for installation of such items as sleeves, pipes, conduits, inserts and hangers in a manner that will not impair or weaken concrete construction.

### 3.3 REINFORCEMENT

A. Cleaning and Bending:
   1. Clean metal reinforcement free of loose rust, mill scale, or other coatings that will destroy or reduce the bond.
   2. Perform cutting and bending in the shop. Bend and cut steel cold. Do not bend or straighten bars in a manner that will injure the material.

B. Placement: Arrange and place reinforcement in accordance with the approved shop drawings. Secure in position with chairs, spacers, and ties. Concrete brick may be used to support reinforcement for slabs on grade when approved by the Engineer.

C. Splicing:
   1. Furnish reinforcing bars in full lengths as indicated on the Contract Drawings and approved shop drawings.

2. Do not splice bars unless indicated on the Contract Drawings or approved by the Engineer in writing.
3. When authorized, make splices in accordance with ACI 318. Perform welding in accordance with AWS D12.1.
4. Lap mesh reinforcement not less than one mesh space plus 2 inches, and tie.

D. Concrete Cover:
1. Provide clearance and spacing indicated on the Contract Drawings.
2. Where no clearances are indicated, the thickness of concrete cover over reinforcement shall be:
   a. 3 inches for concrete placed against ground without the use of forms
   b. 2 inches for concrete placed in forms that will be exposed to ground or weather
   c. 1-1/2 inches for formed concrete not exposed to ground or weather
   d. 1 inch for slabs not exposed to ground or weather

**3.4 FORMWORK**

A. Responsibility:
1. The design and construction of formwork are the sole responsibility of the Contractor.
2. The Contractor shall remove and replace forms which no longer have smooth surfaces and/or are weak resulting in intrusions or extrusions in the concrete face.

B. Design Criteria:
1. Design formwork system which is adequately braced and has strength and stability to insure finished concrete within the tolerances specified in ACI 347.
2. Provide formwork sufficiently tight to prevent leakage of mortar.
3. Chamfer external and exposed corners 1 inch.

C. Coating Forms:
1. Coat forms with bond breaker prior to the placement of reinforcing steel.
2. Do not allow excess form coating material to stand in puddles in the forms or to come in contact with concrete against which fresh concrete is to be placed.
3. Clean reinforcing steel that has become contaminated with bond breaker to the satisfaction of the Engineer prior to placing concrete.

D. Embedded Items:
1. Clean items to be embedded in concrete free from oil or foreign matter that would weaken the bond of the concrete to these items.
2. Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these specifications. Close ends of conduits, piping, and sleeves embedded in concrete with caps or plugs.

E. Joints:
1. Make contraction, expansion, and construction joints where indicated on the Contract Drawings. Additional construction joints are subject to prior approval of the Engineer. Locate additional construction joints to least impair the strength of the structure.
2. Form keyways and joints as indicated on the Contract Drawings.
3. Continue reinforcing steel and wire fabric across construction joints.
4. Install premolded joint filler at locations indicated. Extend filler from bottom of concrete. Seal as indicated on the Contract Drawings. Make splices in premolded filler in manner to preclude

penetration of concrete between joint faces.

F. Waterstops:
   1. Install waterstops of the sizes and shapes indicated. Support and protect that portion of the waterstop which extends beyond the bulkhead during placing of concrete and subsequent removal of forms.
   2. Continuous at construction and expansion joints in Concrete Groups D, E, F, and G of Table I. Continuous at other locations as indicated on the Contract Drawings.
   3. Minimum Width: 9 inches, Maximum Width: 12 inches.
   4. Make field splices by heat-sealing, maintaining the continuity of the ribs and bulbs, and allow the splice to cool before stressing. Field splice must be watertight. Repair damaged waterstops.

**3.5 PREPARATION OF EQUIPMENT AND PLACE OF DEPOSIT**

A. Before placement, clean equipment for mixing and transporting the concrete. Remove debris and ice from the places to be occupied by the concrete. Clean reinforcement of dirt, loose rust, and mill scale, or other coatings.
B. Remove water from place of deposit before concrete is placed. Remove laitance and unsound material from hardened concrete before additional concrete is added.
C. Thoroughly wet the stone base on which slabs are to be placed where no vapor barrier is indicated.

**3.6 MIXING**

A. Mix and deliver ready-mixed concrete in accordance with ASTM C94.
B. Do not over-mix. Do not use concrete which is retained in mixers so long as to require additional water in excess of design mix water to permit satisfactory placing.
C. Use preparation methods capable of producing concrete with a temperature not more than 85 degrees Farenheit, and not less than 55 degrees Farenheit, at the time of placement.
D. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, within the specified temperatures.
E. Do not heat water in excess of 140 degrees Farenheit.
F. Control of Admixtures:
   1. Air-entraining admixtures and other required and/or approved admixtures shall be charged into the mixer as solutions and shall be measured by means of an acceptable mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.
   2. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
   3. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first.

**3.7 CONVEYING**

A. Convey concrete from the mixer to the final deposit by methods that will prevent segregation or loss of materials.

**3.8 CONCRETE PLACEMENT**

A. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not use vibrators to move concrete horizontally with the forms.
B. Do not use retempered concrete or concrete contaminated by foreign material.
C. Plan and conduct concrete placement to insure that the concrete is kept plastic and that the concrete is free of cold joints.
D. Where there is a time delay greater than 45 minutes between adjacent concrete placement, a bulkhead construction joint, complete with waterstops where required, must be installed.
E. Remove temporary spreaders in forms when concrete has reached an elevation rendering their service unnecessary.
F. Do not commence placing when the sun, heat, wind or limitations of facilities provided prevent proper finishing or curing.
G. Discontinue concreting when the descending natural air temperature falls lower than 40 degrees Farenheit unless preparations are made and in place to heat or insulate concrete in accordance with the cold weather concreting requirements of this specification.

**3.9 CONSOLIDATION**

A. Consolidate concrete thoroughly as it is placed in order to secure a dense mass. Work concrete well around the reinforcement and embedded items and into the corners of the forms.
B. Use internal vibrators inserted vertically over the entire area of the placement.
C. Vibrate until voids are eliminated, coarse aggregate is suspended in mortar, and entrapped air bubbles begin to rise to the surface. Concrete shall move back into the space vacated by the vibrator.
D. Space vibrator insertions such that the area visibly affected by the vibrator overlaps the adjacent just-vibrated area by a few inches.
E. Penetrate at least 6 inches into previously placed layers in order to bond between layers and avoid cold joints.
F. Form vibrators may not be used.
G. Take care not to over-vibrate air entrained concrete. Place vibrator to eliminate honeycombing but avoid excess vibrating that bleeds all entrapped air from the mix.
H. Do not use vibrators to transport concrete.

**3.10 JOINTS AND KEYWAYS**

A. Construct expansion, control, and isolation joints and keyways where indicated on the Contract Drawings and at additional locations approved by the Engineer.
B. Where the placing of concrete is discontinued, clean off laitance and other objectionable material to a sufficient depth to expose sound concrete as soon as concrete is firm enough to retain its form. Smooth the top surface of concrete adjacent to the forms with a trowel to minimize visible joints on exposed faces.
C. Immediately after the work of placing concrete is halted, remove accumulations splashed upon the reinforcement and the surfaces of the forms. Perform this removal before concrete takes its initial set. Clean reinforcing steel carefully to prevent damage to the concrete steel bond.
D. Do not halt work within 18 inches of the top of any face.

E. For bonded horizontal joint construction, roughen the surface and expose the aggregate. Clean the surface thoroughly by wet sandblasting, by cutting with high-pressure water jet or by other approved methods. Perform cleaning after the concrete has hardened to prevent raveling of the surface below the desired depth.
F. Before bonding concrete is placed, clean the surface of loose or soft particles or other objectionable materials and keep wet for a minimum period of 12 hours.
G. Cover the cleaned and saturated surface with a coating of neat cement grout and deposit new concrete before the grout has attained its initial set.

**3.11 PERIMETER INSULATION**

A. Install under perimeter of concrete floor slabs, along exterior walls where indicated on the Contract Documents.

**3.12 CONCRETE PROTECTION**

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperature and mechanical injury. Maintain with minimum moisture loss and relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.
B. After the concrete has hardened, loosen forms as soon as possible without damage to the concrete, and run curing water continuously down inside the form.

**3.13 REMOVAL OF FORMS**

A. Do not remove forms until members have acquired sufficient strength to support their own weight and imposed loads safely.
B. Forms for walls, columns, and other vertical faces which do not sustain loads may be removed 12 hours after the last portion of concrete in the section has been placed provided that the concrete has sufficiently hardened as described above.
C. In cold weather, all forms must remain in place for 5 days except those in Concrete Groups C and F of Table I where the requirement is 3 days.
D. Notify the Engineer before forms are removed in order that an examination of the newly-stripped surfaces may be made prior to patching.

**3.14 REPAIR OF TIE HOLES AND MINOR DEFECTS**

A. Repair immediately after form removal.
B. Honeycombs and Small Defective Areas:
    1. Remove to sound concrete.
    2. Wet the affected area.
    3. Brush on bonding grout - 1 part cement, 1 part fine sand and water to produce a consistency of thick cream.
    4. Apply patching mortar - 1 part cement, 2-1/2 parts sand and enough water to produce a stiff consistency.
    5. Consolidate patching mortar and strike off to leave the patch slightly higher than the surrounding surface.
    6. Finish the repaired area flush with the surrounding area after the mortar has been in place for one hour.

C. Tie Holes:
   1. Thoroughly clean and dampen.
   2. Fill solid with patching mortar.
D. Perform patching before curing compound is applied.
E. Cure patched areas in the same way as adjacent concrete.
F. Make repairs uniform in color and finish with surrounding concrete.

**3.15 CURING**

A. Keep concrete moist for at least 7 curing days after placement. Concrete Groups C and F of Table I must be kept moist for only 3 curing days.
B. A curing day is defined as 24-hour day when the concrete surfaces are kept moist and the uniform temperature of the concrete mass is between 55 degrees Farenheit and 75 degrees Farenheit.
C. Curing may be achieved by water curing or application of a liquid membrane-forming curing compound. Curing compounds may not be used on surfaces that are to receive additional concrete, paint or tile.
D. Water curing is the preferred method of protection. Cover exposed surfaces with a saturated material (burlap or cotton mats) and keep wet continuously with a soil soaker hose for 7 days. Leave covering in place, without wetting, for an additional 3 days.
E. The use of curing compound (ASTM C309) is permissible. Keep surfaces moist after the forms are removed and the form tie holes repaired. After the surfaces are finished, apply the curing compound according to the manufacturer's recommendations. Do not remove too much forming at one time.
F. Slabs: Immediately following slab finishing, apply liquid membrane-forming curing compound or begin water curing before the surface becomes dry.
G. Vertical Surfaces: When the forms are removed entirely, spray the surface with water and allow to reach a uniformly damp appearance with no free water on the surface. Apply curing compound or begin water curing.

**3.16 CONCRETE WALL FINISHES**

A. Refer to Table II for type finish at each location.
B. Rough Form Finish:
   1. No form facing materials specified.
   2. Patch tie holes and defects.
   3. Chip off fins 1/4 inch or more in height.
C. Smooth Form Finish:
   1. Use a form facing material that will produce a smooth, hard, uniform texture on the concrete.
   2. Keep seams to a practical minimum.
   3. Patch tie holes and defects.
   4. Remove all fins.
D. Smooth Rubbed Finish:
   1. Produce a smooth form finish.
   2. Wet surface and rub with a carborundum brick until uniform color and texture are produced.
   3. Perform rubbing no later than 24 hours after forms are removed.
   4. Do not use any cement grout other than the paste drawn from the concrete itself by rubbing.
   5. Thoroughly wash the surface with water.

E. Smooth Troweled Finish:
   1. Produce a smooth rubbed finish.
   2. After wet-rubbing, finish with a steel trowel to increase compaction of fines and to provide maximum density.

F. Smooth Finish (Grout Cleaned):
   1. Use for architectural surfaces exposed to general view, unless other indicated.
   2. Mix 1 part portland cement and 1-1/2 parts fine sand with sufficient water to produce grout having consistency of thick paint; use white portland cement for cement grout.
   3. Wet surface of concrete and uniformly apply grout with brush or spray gun completely filling air bubbles. Surface with a wood float scouring wall vigorously.
   4. Allow grout to partially set for one to two hours, depending on weather conditions. In hot dry weather, keep damp, using fine fog spray.
   5. When grout has hardened sufficiently to be scraped from wall with edge of steel trowel without removing grout from small air holes, cut off all grout that can be removed with trowel.
   6. Allow surface to dry thoroughly then rub vigorously with dry burlap to completely remove dried grout. There shall be no visible film or grout remaining after this rubbing.
   7. The entire cleaning operation for any area must be completed the day it is started. No grout shall be left on wall overnight, and sufficient time shall be allowed for grout to dry after it has been cut with trowel so it can be wiped off clean with burlap.
   8. After entire surface has been grout cleaned, wipe off any slightly dark spots or streaks with fine abrasive hone.

**3.17 CONCRETE SLAB FINISHING**

A. Refer to Table II for type finish at each location.

B. Complete screeding and darbying slabs before excess moisture or bleeding water is present on the surface.

C. Do not begin subsequent finishing operations until surface water has disappeared and the concrete will sustain foot pressure with only approximately 1/4" indentation.

D. Float Finish:
   1. Consolidate concrete with a power-driven disc-type float or a combination floating-troweling machine with metal float shoes attached.
   2. Machines which have a water attachment for wetting the concrete during the finishing operation are prohibited.
   3. Unless otherwise indicated in Table II, check and level surface plane to a tolerance not exceeding 1/4 inch in 10 feet when tested with a 10-foot straightedge. Cut down high spots and fill low spots. Immediately after re-leveling, refloat surface to a uniform, smooth, granular texture.
   4. Where slab drainage is indicated, take care to maintain accurate slopes for drainage.

E. Steel Troweling: After float finishing, steel trowel surface as specified in Table II to increase the compaction of fines and to provide maximum density and wear resistance.

F. Integral Finishes:
   1. Use for slabs where some material other than concrete will be the final wearing surface.
   2. Screeded Finish - Place screed blocks at frequent intervals and strike off to surface elevations desired. Unless otherwise indicated, use on base slabs upon which grout finish, regular mortar

bed ceramic tile, sand cushion terrazzo or similar type wearing surface is applied.

3. Steel Troweled Finish - Use on concrete slabs for resilient floors, ceramic tile using thin bed method, seamless flooring, epoxy or latex terrazzo, carpet and wood.

G. Non-slip Broom Finish: In addition to floating and troweling, provide walks, ramps, steps, and exposed floor areas subject to foot traffic and likely to be wet with a final non-slip broom finish. Draw broom over previously finished finish.

H. Expansion Joints:
1. Edge or lightly stone the edges of expansion and contraction joints after the forms are stripped and before the adjacent slab is placed.
2. Leave joints in the completed work carefully tooled and free of mortar and concrete.
3. Leave joint filler exposed for its full length with clean and true edges.
4. Apply sealant at expansion joints where indicated.

I. Hardener Floor Treatment: Install in accordance with manufacturer's instructions.

**3.18 HOT WEATHER REQUIREMENTS**

A. Hot weather conditions are deemed to exist when the temperature in the forms is 75 degrees Farenheit or above, or a combination of high air temperature, low relative humidity and wind velocity impairs the quality of fresh or hardened concrete. Take protective measures for mixing, transporting and placing concrete in accordance with ACI 305R.

B. The temperature of the concrete at the place of discharge may not exceed 85 degrees Farenheit.
1. If ice is used to lower temperature, place crushed, shaved or chipped ice directly into the mixer as part or all of the mixing water. Mix until ice is completely melted.
2. Record the concrete temperature at the time of discharge.

C. Do not add water that will cause the proportions to exceed the maximum water-cement ratio shown in Table I.
1. Notify the resident project representative before adding any water to the concrete mix.
2. Record the amount of water added to the concrete at the jobsite.

D. Discharge concrete within 90 minutes or 300 revolutions, whichever occurs first, after the first mixing of cement and aggregates.

E. Placing and Curing:
1. Place concrete promptly upon arrival.
2. Provide at least one standby vibrator for each 3 vibrators in use.
3. Protect concrete from direct sunlight. Keep forms covered and moist by means of water sprinkling or the application of continuously wetted burlap or cotton mats for a minimum of 24 hours.
4. When forms are removed, provide wet cover to the newly exposed surfaces to avoid exposure to hot sun and wind.
5. Continue specified water curing methods for 10 days. Leave covering in place 4 additional days. Do not permit alternate wetting and drying cycles.
6. For slabs on grade, beam and deck concrete, and other horizontal placements, protect the surface between finishing operations using one or more of the following methods:
   a. Careful use of a fog nozzle.
   b. Spreading and removing polyethylene sheeting between finishing operations.

c. Application of monomolecular film after the strike off.

**3.19 COLD WEATHER REQUIREMENTS**

A. Cold weather is defined any time when the daily temperature is 40 degrees F or lower during placement and the protection period.
B. Protect concrete surfaces from freezing for at least 24 hours after placement.
C. All surfaces in contact with newly-placed concrete including formwork, reinforcement and subgrade must be above 35 degrees Farenheit.
D. Place concrete at a temperature of not less than 55 degrees Farenheit. Mix concrete at a temperature between:
   1. 60 degrees Farenheit and 70 degrees Farenheit when outside air temperature is above 30 degrees Farenheit.
   2. 65 degrees Farenheit and 75 degrees Farenheit when outside air temperature is between 0 degrees Farenheit and 30 degrees Farenheit.
   3. 70 degrees Farenheit and 80 degrees Farenheit when outside air temperature is below 0 degrees Farenheit.
E. Follow concrete placement with tarpaulins or other readily movable coverings, so only a few feet of concrete is exposed to the outside air at any time.
F. Maintain the temperature and moisture conditions specified in all parts of the newly-placed concrete by covering, insulating, housing or heating. Arrange for protection methods in advance of placement.
G. Maintain concrete at a temperature of not less than 50 degrees Farenheit nor more than 70 degrees Farenheit for a period of 3 days after placement. Only 2 days are required for Concrete Groups C and F of Table I.
H. Do not remove forms during the initial protection period.
I. Protect insulation against wetting that will impair its insulating value using moisture-proof cover material. Keep insulation in close contact with concrete.
J. Construct enclosure to withstand wind and snow loads and be reasonably air-tight. Provide sufficient space between the concrete and enclosure to permit free circulation of heated air.
K. Use vented heaters. Do not permit heaters to heat or dry concrete locally.
L. Maintain relative humidity above 40 percent within heated enclosures before construction supports are removed.
M. Monitor temperature to insure concrete is kept within specified limits recording time and concrete temperature every 8 hours.
N. Assure concrete has developed necessary strength before removing forms. Provide additional test cylinders with the same protection as the structure they represent to verify concrete strength before construction supports are removed.
O. If water curing is used, terminate at least 12 hours before end of temperature protection period. Permit concrete to dry.
P. After the required protection period, gradually reduce the concrete temperature within an enclosure or insulation at a rate not to exceed 20 degrees Farenheit per day until the outside temperature has been reached.
Q. Apply membrane-forming curing compound to concrete surfaces during the first period of above-freezing temperatures after forms are stripped and before air temperature rises to 50 degrees F. Apply

membrane-forming curing compound to slabs as soon as finishing operations are completed, except where live steam curing is used.

**3.20 MISCELLANEOUS CONCRETE ITEMS**

A. Concrete Sidewalks and Pads:
   1. Sidewalks and pads shall be 4000 psi air entrained concrete sidewalk slabs 5 inches thick, pads of thickness indicated.
      a. Sidewalk slabs 5 inches thick
      b. Pads of thickness indicated
   2. Subgrade shall be properly prepared and thoroughly wetted before placing concrete.
   3. Unless otherwise indicated:
      a. Construct sidewalks in separate slabs 20 feet in length except for closures; slabs separated by 1/4 inch thick transverse expansion joints.
      b. Between expansion joints, divide slabs into blocks 5 feet in length by scoring transversely.
      c. Slabs more than 5 feet in width, score longitudinally in center.
      d. Scoring shall extend at least a third of slab thickness into slab.

B. Concrete Curbs:
   1. Construct of 4000 psi concrete with air entrainment, where indicated on Drawings; use expansion material between curbs and sidewalks and at control joints.
   2. Curbs shall include one construction joint every 10 feet and one expansion joint every 30'.
   3. Concrete curbs shall be installed according to local Government requirements.

C. Retaining Walls: Provide 2 inch weepholes at 6 feet off center; 8 inches above grade on low side of wall.

**SEE ATTACHED TABLES**

**TABLE 1**

**PROPERTIES OF CEMENT CONCRETE**

| Concrete Group | REQD 7 Day Strength (psi) | REQD 28 Day Strength (psi) | Reinf. Steel Grade | Water / Cement Ratio | Max. % Air Content | Min. / Max. Slump (In.) | Max. C3A (%) | Cement Type | Max. Aggre-gate Size (In.) |
|---|---|---|---|---|---|---|---|---|---|
| A | 2,100 | 3,000 | 60 | 0.51 | 5 +/- 1 | 2-4 | ------ | I or IA | 1-1/2 |
| B | 2,100 | 3,000 | 60 | 0.51 | 6 +/- 1 | 2-4 | ------ | I or IA | 1 |
| C | 2,100* | 3,000 | 60 | 0.57 | 5 +/- 1 | 2-4 | ------ | III or IIA | 1-1/2 |
| D | 2,800 | 4,000 | 60 | 0.45 | 5 +/- 1 | 2-4 | ------ | I or 1A | 1-1/2 |
| E | 2,800 | 4,000 | 60 | 0.45 | 5 +/- 1 | 2-4 | 8 | II or IIA | 1-1/2 |
| F | 2,800* | 4,000 | 60 | 0.46 | 5 +/- 1 | 2-4 | ------ | III or IIIA | 1-1/2 |
| G | 3,150 | 4,500 | 60 | 0.42 | 5 +/- 1-1/2 | 2-4 | 8 | II or IIA | 1-1/2 |
| H | 2,800 | 4,000 | 60 | 0.45 | 1.5 +/- 0.5 | 2-4 | ------ | I | 1 |
| I | 1,500 | 2,000 | 60 | 0.67 | 5 +/- 1 | 2-6 | ------ | I or IA | 1-1/2 |
| J | 3,500 | 5,000 | 60 | 0.40 | 6 +/- 1.5 | 2-4 | ____ | II or IIA | 1-1/2 |

*Compressive Strength at 3 Days

**TABLE II**

**CONCRETE FINISH SCHEDULE**

| LOCATION | CONCRETE GROUP | FINISH | REMARKS |
|---|---|---|---|
| Tanks | J | Smooth Rubbed Finish<br><br>Rough Form<br><br>Float Finish | Exposed Exterior Faces of Walls to 1 Ft. Below Grade and Interior Faces of Walls and Underside of Elevated Slabs/Beams<br><br>Buried Faces of Walls<br><br>Top of Tank Base Slab |
| UV Reduction Baffle and Existing Weir Fill | G | Smooth Finish, Grout Cleaned | |
| Slabs on Grade and Elevated Floors on Metal Deck | H | Steel Troweled | Tops of Slabs |
| Sidewalks/Entrance Pads/ Equipment Pads/ Concrete Stairs | J | Non-Slip Broom Finish | |
| Frostwalls/Piers | J | Smooth Rubbed Finish<br><br>Rough Form | Exposed Exterior Faces of Walls to 1 Ft. Below Grade<br><br>Buried Faces of Walls |
| Footings | J | Rough Form | |

**END OF SECTION 03 30 00**

**SECTION 03 40 00**
**PRECAST CONCRETE STRUCTURES**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:
   1. Precast Concrete Wet Well and Valve Vault

### 1.2 QUALITY ASSURANCE

A. Design Criteria:
   1. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890 live loading and installation conditions, and manufactured to conform to ASTM C913.
   2. Minimum 28-day Compressive Strength: 4,000 psi
   3. Honeycombed or retempered concrete will not be acceptable.

B. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
      b. A496 Specifications for Steel Wire, Deformed, for Concrete Reinforcement
      c. A615 Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
      d. B221 Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
      e. C33 Specifications for Concrete Aggregate
      f. C150 Specification for Portland Cement
      g. C260 Specification for Air-Entraining Admixtures for Concrete
      h. C478 Specifications for Precast Reinforced Concrete Manhole Sections
      i. C497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
      j. C858 Underground Precast Concrete Utility Structures
      k. C890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
      l. C891 Practice for Installation of Underground Precast Concrete Utility Structures
      m. C913 Specifications for Precast Concrete Water and Wastewater Structures.
      n. C990 Specifications for Joints for concrete Pipe, Manholes, and Precast box Sections Using Preformed Flexible Joints Sealants
      o. D4101 Specification for Propylene Plastic Injection and Extrusion Materials

C. The precast concrete structures shall have sufficient weight to counteract the buoyancy uplift from ground water that is at a level equal to the top of the structures with a factor of safety of 1.5. Provide calculations demonstrating this requirement is being met. The Contractor shall add additional weight as needed by installing a poured-in-plate anchoring collar that is structurally anchored to the precast structure via screwed in dowel rods.

### 1.3 SUBMITTALS

A. Design Drawings and Product Data:

1. Submit detailed shop drawings or design drawings to the Engineer for approval prior to fabrication.
2. Include details of reinforcing steel, joint design, concrete mix design, and loading calculations.

B. Submit certification from the precast structures manufacturer attesting that the structures meet or exceed Contract Specifications.

**1.4 PRODUCT DELIVERY, STORAGE AND HANDLING**

A. Transport and handle precast concrete units with equipment designed to protect the units from damage.
B. Do not place units in position which will cause overstress, warp or twist.
C. Separate stacked members with battens across the full width of each bearing point.
D. Stack so that lifting devices are accessible and undamaged, and identification marks are discernible.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Portland Cement: ASTM C150, Type II
B. Coarse Aggregates: ASTM C33; Graded 1" to No. 4 Sieve.
C. Sand: ASTM C33; 2.35 fineness modulus
D. Water: Potable; clean and free of injurious amounts of acids, alkalis, salts, organic materials, or other substances that may be incompatible with concrete or steel.
E. Air-Entraining Admixtures: ASTM C260
F. Reinforcing Steel:
   1. Deformed Bars: ASTM A615, Grade 40
   2. Welded Wire Fabric: ASTM A185
G. Joint Sealant:
   1. ASTM C990

**2.2 MIXES**

A. Design concrete mix to produce the required concrete strength, air-entrainment, watertight properties, and loading requirements.

**2.3 FABRICATION AND MANUFACTURE**

A. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the Contract Drawings, and to the specified design criteria.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Unless otherwise specified herein below, the precast units shall be installed in accordance with ASTM C891.
B. Install precast concrete units to the elevation and location indicated on the Contract Drawings.
C. Install required pipe connections, valves, baffles and other appurtenances as indicated on the Contract Drawings.

**3.2 BACKFILLING STRUCTURES**

A. Do not backfill precast concrete structures until after examination and approval of the Engineer.
B. Backfill structures in accordance with Section 31 20 00 - Earthwork.

**END OF SECTION 03 40 00**

**SECTION 03 41 13**
**PRECAST CONCRETE HOLLOW CORE PLANKS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Precast floor planks.
B. Connection plates with brackets and hangers.

### 1.2 RELATED REQUIREMENTS

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

### 1.3 REFERENCE STANDARDS

A. ACI 301 - Specifications for Concrete Construction 2020.
B. ACI 318 - Building Code Requirements for Structural Concrete 2019 (Reapproved 2022).
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
E. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
F. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars 2018, with Amendment (2020).
G. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products 2021.
H. PCI MNL-120 - PCI Design Handbook 2017, with Errata (2021).
I. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete 1988.
J. PCI MNL-124 - Design for Fire Resistance of Precast Prestressed Concrete 2011.
K. PCI MNL-126 - PCI Manual for the Design of Hollow Core Slabs and Walls 2015.
L. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction 2000.
M. PCI (CERT) - PCI Plant Certification Current Edition.

### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate location of hanger tabs and devices for mechanical and electrical work and cutting of field openings.
B. Preinstallation Meeting: Convene one week before starting work of this section.
   1. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

### 1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.
C. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
D. Welders' Certificates.
E. Designer's Qualification Statement.

### 1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design precast concrete hollow core planks under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in State of Maryland.
B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
C. Welder Qualifications: Qualified within previous 12 months in accordance with AWS B2.1/B2.1M.

### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
B. Mark each member with date of production and final position in structure.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Precast Concrete Hollow Core Planks:
    1. Any manufacturer with PCI Plant Certification.
    2. Any manufacturer with NPCA Plant Certification.

### 2.2 PRECAST UNITS

A. Precast Hollow Core Planks: Comply with PCI MNL-120, PCI MNL-126, PCI MNL-124 ACI 318, and ACI 301.
    1. Dimensions as indicated on drawings.
    2. Design components to withstand dead loads and design loads in the configuration indicated on drawings and as follows:
        a. Floor Assembly: 250 pounds per square foot live load.
        b. Maximum Allowable Deflection of Floor Planks: 1/240 of span , cambered to achieve flat surface under dead load.
    3. Design connections in accordance with PCI MNL-123.
    4. Design components to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.
    5. Fire Resistance: Design planks in accordance with PCI MNL-124 to achieve hourly ratings as follows:
        a. Floor Assembly: one hour.

### 2.3 MATERIALS

A. Concrete Materials: ACI 301.
B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) deformed steel bars.
C. Non-Shrink Grout: Non-metallic, minimum compressive strength of 10,000 psi at 28 days.

### 2.4 ACCESSORIES

A. Connecting and Supporting Devices: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts: ASTM A36/A36M carbon steel; prime painted.

B. Bearing Pads: High density plastic, 1/8 inch thick, smooth on one side. Vulcanized elastomeric compound molded to size.

**2.5 FABRICATION**

A. Weld reinforcing in accordance with AWS D1.4/D1.4M.
B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
C. Provide openings required by other sections, at locations indicated.
D. Plant Finish: Finish members to PCI MNL-116 Commercial Grade.
E. Connecting and Supporting Steel Devices: Do not paint surfaces in contact with concrete or surfaces requiring field welding.

**2.6 FABRICATION TOLERANCES**

A. Comply with PCI MNL-116 and PCI MNL-135.

**2.7 SOURCE QUALITY CONTROL**

A. Produce planks in accordance with requirements of PCI MNL-116. Maintain plant records and quality control program during production of precast planks. Make records available upon request.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

**3.2 PREPARATION**

A. Prepare support devices for the erection procedure and temporary bracing.

**3.3 ERECTION**

A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
B. Install bearing pads at bearing ends of planks as indicated.
C. Align and maintain uniform horizontal and end joints, as erection progresses.
D. Maintain temporary bracing in place until final connection is made. Protect members from staining.

**3.4 TOLERANCES**

A. Erect members level and plumb within allowable tolerances. Comply with PCI MNL-135.

**3.5 PROTECTION**

A. Protect members from damage caused by field welding or erection operations.
B. Provide non-combustible shields during welding operations.

**3.6 CLEANING**

A. Clean weld marks, dirt, and blemishes from surface of exposed members.

**END OF SECTION 03 41 13**

**SECTION 03 42 00**
**PRECAST STRUCTURAL CONCRETE**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section includes:
   1. Precast structural concrete hollow core plank units.

### 1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.
B. Product Data: For each type of product indicated.
C. Design Mixes: Provide back-up test data conforming to ACI requirements for each concrete mix.
D. Shop Drawings: Detail fabrication and installation of precast structural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, openings, and types of reinforcement, including special reinforcement.
   1. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
   2. Indicate locations and details of anchorage devices to be embedded in other construction.
   3. Shop Drawings shall be prepared by or under the direct supervision of qualified Professional Engineer registered in the State of Maryland.
E. Design Calculations: Comprehensive engineering analysis signed and sealed by the qualified Professional Engineer registered in the State of Maryland responsible for its preparation, submitted for Owner's records. Include cover letter signed and sealed by responsible engineer indicating building code and design criteria used for analysis and stating that analysis was performed by or under his or her direct supervision. Include calculated fire-resistance analysis.
F. Samples: For each type of finish indicated on exposed surfaces of precast structural concrete units, in sets of 3, illustrating quality of finishes, colors, and textures; approximately 12 by 12 by 2 inches.
G. Welding Certificates: Copies of certificates for welding procedures and personnel.
H. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers and Owners, and other information specified.
I. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
   1. Concrete materials.
   2. Reinforcing materials and prestressing tendons.
   3. Admixtures.
   4. Bearing pads.

### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed precast structural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance.
    1. Assumes responsibility for designing precast concrete structural units and connections to comply with performance requirements. This responsibility includes preparation of Shop Drawings and design calculations by a qualified professional engineer.
    2. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Category C2.
    3. Has sufficient production capacity to produce required units without delaying the Work.
C. Engineer Qualifications: A professional engineer who is licensed to practice in the State of Maryland and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for precast structural concrete units and connections that are similar to those indicated for this Project in material, design, and extent.
D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
E. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."
F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."
G. Product Options: Drawings indicate size, profiles, and dimensional requirements of precast concrete units and are based on the specific types of units indicated. Other fabricators' precast concrete units complying with requirements may be considered. Refer to Division 01.
H. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel." All welding shall be performed by certified welders only.
I. Calculated Fire Resistance: Where indicated, provide precast structural concrete units whose fire resistance has been calculated according to PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.
J. Fire Test Response Characteristics: Provide precast structural concrete units that comply with the following requirements:
    1. Fire-response testing was performed by UL, or another testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
    2. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory," or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
    3. Products are identified with appropriate markings of applicable testing and inspecting agency.

K. Mockups: Before installing precast structural concrete units, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by the Engineer.
   2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
   3. Obtain Engineer's approval of mockups before starting fabrication.
   4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   5. Demolish and remove mockups when directed.
   6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

L. Preinstallation Conference: Conduct conference at Project site.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast structural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.

B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

### 1.6 SEQUENCING

A. Furnish anchorage items to be embedded in other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Provide precast structural concrete units and connections, including connections to support framing and/or foundations, capable of withstanding design loads within limits and under conditions indicated including, but not limited to, indicated building code and FEMA 361 design criteria.

C. 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.

D. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 18 to plus 120 deg F.

### 2.2 MOLD MATERIALS

A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.

## 2.3 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706 deformed.
D. Steel Bar Mats: ASTM A 184, assembled with clips, ASTM A 615, Grade 60 or ASTM A 706, deformed bars.
E. Plain-Steel Wire: ASTM A 82, as drawn.
F. Deformed-Steel Wire: ASTM A 496.
G. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
H. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
I. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice," PCI MNL 116, and as follows:
    1. For uncoated reinforcement, use all-plastic, CRSI Class 1 plastic-protected, or CRSI Class 2 stainless-steel bar supports.
    2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire or all-plastic bar supports.

## 2.4 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A 416, Grade 250 or 270, uncoated, 7-wire, low-relaxation strand.

## 2.5 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, of same type, brand, and source.
B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 5S.
C. 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.
D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
E. Water-Reducing Admixture: ASTM C 494, Type A.
F. Retarding Admixture: ASTM C 494, Type B.
G. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
H. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
I. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
J. Plasticizing Admixture: ASTM C 1017.
K. Fly Ash Admixture: ASTM C 618, Class C or F.
L. Metakaolin Admixture: ASTM C 618, Class N.
M. Silica Fume Admixture: ASTM C 1240.
N. Calcium chloride or admixture containing chlorides shall not be used.

## 2.6 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36.
B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type B, with arc shields.
C. Malleable Steel Castings: ASTM A 47.
D. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.
E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.
F. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
G. Finish:
    1. Apply zinc coating by hot-dip process according to ASTM A 123, after fabrication, and ASTM A 153, as applicable typical except provide electrode position according to ASTM B 633, SC 3 for threaded fasteners.
    2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
H. Welding Electrodes: Comply with AWS standards.
I. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast structural concrete units.

## 2.7 BEARING PADS

A. Provide bearing pads for precast structural concrete units as follows:
    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 A durometer, minimum tensile strength 2250 psi per ASTM D 412.
    2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer.

## 2.8 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
B. Nonmetallic, Non-shrink Grout: Premixed, nonmetallic, noncorrosive, non-staining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application.
C. Epoxy Grout: ASTM C 881, 2-component epoxy resin, of type, grade, and class to suit requirements.

## 2.9 CONCRETE MIXES

A. Prepare design mixes for each type of concrete required.
B. Limit use of fly ash and silica fume to not exceed, in aggregate, 25 percent of portland cement by weight.
C. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
D. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318.

E. Normal-Weight Concrete: Proportion mixes 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 minimum.
   2. Maximum Water-Cementitious Materials Ratio: 0.40.
   3. 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, with a tolerance of plus or minus 1-1/2 percent:
      a. Air Content: 2.5 to 4.5 percent.

F. Other Admixtures: Use water-reducing, high-range water-reducing, water-reducing and accelerating, or water-reducing and retarding admixtures according to manufacturer's written instructions.

G. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

**2.10 FABRICATION**

A. General: Design and fabricate precast concrete units to dimensions and details indicated.
   1. Furnish units free of voids and honeycombs.
   2. Provide standard finish to precast concrete units.
      a. For members receiving concrete topping, finish of tops of precast concrete units for bonding with concrete floor topping shall be per precast manufacturer's recommendations.
      b. For members not receiving concrete topping, provide standard finish to precast concrete units.
   3. Reinforce units to resist transportation and erection stresses.
   4. Include cast-in weld plates where required.
   5. Coordinate with other trades for installation of cast-in items.
   6. Provide headers of cast-in-place concrete or structural steel shapes for openings larger than one slab width according to precast concrete unit fabricator's written recommendations unless indicated otherwise.

B. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances.
   1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's written instructions.
   2. Unless forms for precast, prestressed concrete units are stripped before detensioning, design forms so stresses are not induced in precast concrete units because of deformation or movement of concrete during detensioning.

C. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.

D. Cast-in openings larger than 10 inches in diameter or 10 inches square according to Shop Drawings. Smaller holes may be field cut by trades requiring them, as approved by Engineer.

E. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" 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.
   2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
   3. Place reinforcement to obtain at least the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
   4. Install welded wire fabric 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.

F. Prestress tendons for precast structural concrete units by either pretensioning or posttensioning methods. Comply with PCI MNL 116.
   1. Delay detensioning until concrete has reached at least 70 percent of its compressive strength as established by test cylinders cured under the same conditions as concrete.
   2. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
   3. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

G. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.

H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.

I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.

J. Comply with ACI 306.1 procedures for cold-weather concrete placement.

K. Comply with ACI 305R recommendations for hot-weather concrete placement.

L. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast concrete unit on a surface that will not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

N. Product Tolerances: Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product tolerances.

O. Finish formed surfaces of precast structural concrete with normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color

variations, form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.

P. Screed finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections.

Q. Apply precast manufacturer's recommended finish to precast concrete units that will receive concrete topping after installation.

R. Recess prestressing tendons a minimum of 1/2 inch, fill recesses with grout, and apply a sack finish to vertical ends of precast concrete units.

**2.11 SOURCE QUALITY CONTROL**

A. Employ an independent testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

B. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Using Agency's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

C. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.

D. Strength of precast concrete units will be considered deficient if units fail to comply with PCI MNL 116 requirements, including the following:
   1. Units fail to comply with compressive-strength test requirements.
   2. Reinforcement and prestressed tendons of units do not comply with fabrication requirements.
   3. Concrete curing and protection of units against extremes in temperature fail to comply with requirements.
   4. Units are damaged during handling and erecting.

E. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with PCI MNL 116 requirements, Contractor will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.
   1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer and precast manufacturer.
   2. Cores will be tested in an air-dry condition per ACI 301 if units will be dry under service conditions.
   3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
   4. Test results will be made in writing on the same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports will include the following:
      a. Project identification name and number.
      b. Date when tests were performed.
      c. Name of precast concrete fabricator.
      d. Name of concrete testing agency.
      e. Identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane

of concrete as placed.

F. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

G. Dimensional Tolerances:
   1. Units with dimensions smaller or larger than required and not complying with tolerance limits may be subject to additional testing.
   2. Precast concrete units with dimensions larger than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to comply with construction conditions.

H. Defective Work: Precast concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

A. Bearing Pads: Install bearing pads as precast concrete units are being erected. Set pads on true, level, and uniform bearing surfaces and maintain in correct position until precast concrete units are placed.

B. Install precast structural concrete. Shore and brace precast concrete units to maintain location, stability, and alignment until permanent connections are installed.

C. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with certified welders only.
   1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
   2. Repair damaged metal surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces.
   3. Repair damaged metal surfaces by cleaning and repriming damaged painted surfaces.

D. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Engineer and precast manufacturer.

E. Erection Tolerances: Install precast concrete units level, plumb, square, and true, without exceeding the recommended erection tolerances in PCI MNL 127, "Recommended Practice for Erection of Precast Concrete."

F. Grouting Connections and Joints:
   1. After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:
   2. Provide forms or other approved method to retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for

not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

**3.3 FIELD QUALITY CONTROL**

A. Engage a qualified independent testing and inspecting agency to perform field tests and inspections.
B. Field welds and connections using high-strength bolts will be subject to tests and inspections.
C. Testing agency will report test results promptly and in writing to the Owner, Contractor, and Engineer.
D. Remove and replace work that does not comply with specified requirements.
E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
F. Extent of Inspection and Testing:
    1. Bolted Connections: 100 percent of field-bolted connections shall be visually inspected.
    2. Welded Connections:
        a. 100 percent of field welded connections shall be visually inspected.
        b. 100 percent of partial penetration and full penetration type field-welded connections shall be tested by ultrasonic or radiographic inspection.
        c. 100 percent of any weld suspected of being defective based on visual inspection shall be tested by ultrasonic or radiographic inspection.

**3.4 REPAIRS**

A. Repair precast structural concrete units if permitted by Engineer. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has 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. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

**3.5 CLEANING**

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.
    1. Wash and rinse 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.

**END OF SECTION 03 42 00**

**SECTION 03 60 00**
**GROUT**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:
   1. Portland Cement Grout
   2. Rapid-curing Epoxy Grout
   3. Non-shrink Cementitious Grout
B. Related Work specified elsewhere:
   1. Section 03 30 00 - Cast-in-Place Concrete

### 1.2 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.
B. Submit a Statement of Compliance, Section 00 62 33.14, together with supporting data, from the materials suppliers attesting the conformance of products and ingredients with these specifications.
C. Submit manufacturer's instructions for mixing, handling, surface preparation, and placing the epoxy type grout and non-shrink grout.

## PART 2 PRODUCTS

### 2.1 PORTLAND CEMENT

A. ASTM C150, Type I and II

### 2.2 WATER

A. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities that will cause:
   1. Corrosion of steel,
   2. Volume change that will increase shrinkage cracking,
   3. Efflorescence, or
   4. Excess air entraining

### 2.3 FINE AGGREGATE

A. Washed natural sand.
B. Gradation in accordance with ASTM C33 and represented by a smooth granulometric curve within the required limits.
C. Free from injurious amounts of organic impurities as determined by ASTM C40.

### 2.4 RAPID-CURING EPOXY GROUT

A. High strength, three component epoxy grout formulated with thermosetting resins and inert fillers.
B. Grout shall be rapid-curing, have high adhesion, and be resistant to ordinary chemicals, acids and alkalies.

| Physical Properties | | Reference Standard |
|---|---|---|

| | | |
|---|---|---|
| Compressive Strength | 12,000 psi (7 day) | ASTM C579 |
| Tensile Strength | 2,000 psi minimum | ASTM C307 |
| Coefficient of Expansion | 30x10^-6 in/degrees F | ASTM C531 |
| Shrinkage | None | ASTM C827 |

**2.5 NON-SHRINK CEMENTITIOUS GROUT**

A. Pre-mixed ready for use formulation requiring only the addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.

B. Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with Corps of Engineers Specification CRD-C621, for Type D non-shrink grout:

| | | | |
|---|---|---|---|
| Setting Time: | Initial<br>Final | 2 hours (Approximately)<br>3 hours (Approximately) | ASTM C191 |
| Expansion: | | 0.10% - 0.4% Maximum | |
| Compressive Strength: | 1 day<br>7 days<br>28 days | 4,000 psi<br>7,000 psi<br>10,000 - 10,800 psi | CDR-C621 |

**PART 3 EXECUTION**

**3.1 SURFACE PREPARATION**

A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until a sound, clean concrete surface is achieved.

B. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level and maintain final positioning of components to be grouted.

E. Take special precautions during periods of extreme weather conditions in accordance with the manufacturer's written instructions.

F. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

**3.2 FORMWORK**

A. Construct leakproof forms anchored and shored to withstand grout pressures.

B. Provide clearance between the formwork and the area to be grouted to permit proper placement of grout.

**3.3 MIXING**

A. Portland Cement Grout:

1. Prepare grout composed of portland cement, sand and water; do not use ferrous aggregate or staining ingredients in grout mix.
2. Use proportions of 2 parts sand and 1 part cement, measured by volume.

3. Prepare grout with sufficient water to obtain consistency to permit placing and packing.
4. Mix water and grout in two steps; pre-mix using approximately 2/3 of the water; after partial mixing, add the remaining amount of water to bring mix to the desired placement consistency and continue mixing 2-3 minutes.
5. Mix only that quantity of grout that can be placed within 30 minutes after mixing.
6. After the grout has been mixed, do not add more water for any reason.

B. Non-Shrink Cementitious Grout: Mix and prepare non-shrink cementitious grout in strict accordance with the manufacturer's instructions.

C. Mix grout components as close to the work area as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.

**3.4 PLACING**

A. Place grout material quickly and continuously.

B. Do not use pneumatic-pressure or dry-packing methods.

C. Apply grout from one side only to avoid entrapping air.

D. Do not vibrate the placed grout mixture, or permit it to be placed if the area is being vibrated by nearby equipment.

E. The final installation shall be thoroughly compacted and free of air pockets.

F. Do not remove leveling shims for at least 48 hours after grout has been placed.

**3.5 CURING**

A. After grout has attained its initial set, keep damp for a minimum of 3 days.

B. Prevent rapid loss of water from the grout during the first 48 hours by the use of an approved membrane curing compound or with the use of the wet burlap method.

**3.6 GROUTING PUMP BASE PLATES**

A. Before attaching pump piping, position the pump baseplate on the foundation at the correct elevation supported on leveling jack bolts. Utilize an optical level and adjust jack screws until a level of 0.005 in/ft is obtained in two directions 90 degrees apart. Install grout forms from 3/4" minimum plywood and securely brace. Forms shall extend a minimum of 2" above the top of the pump base plate. Wax the forms to prevent gout adhesion. Provide a 45 degree chamfer at top edge of grout.

B. Place epoxy grout in manner to prevent air entrapment. Use a head box to aid in pouring grout into the base plate grout holes. When the head box is moved to the next grout hole, a 6" high stand pipe shall be placed over the grout hole and filled with grout.

C. After the base plate is full, maintain the stand pipes over the grout holes to continue purging air. When grout has taken an initial set, the stand pipes can be removed. Clean excess grout from all surfaces. Remove forms after grout has adequately cured.

D. After the grout has cured tap the base plate with a ball peen hammer to check for voids. If voids are found, drill several holes in the baseplate in the area of the void and fill the void with epoxy grout having no aggregate.

E. Remove jack screws and fill screw holes with RTV or epoxy.

F. Torque foundation bolts tight. Install pump piping.

G. After grout has attained its initial set, keep damp for a minimum of 3 days.

H. Prevent rapid loss of water from the grout during the first 48 hours by the use of an approved membrane curing compound or with the use of the wet burlap method.

**END OF SECTION 03 60 00**

**SECTION 04 20 00**
**UNIT MASONRY**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Concrete block.
B. Mortar.
C. Reinforcement and anchorage.
D. Accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 03 60 00 - Grout.
B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
C. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

### 1.3 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022.
B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2022.
C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2022.
E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2022.
F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2022.
G. ASTM C150/C150M - Standard Specification for Portland Cement 2022.
H. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
I. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.
J. ASTM C387/C387M - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar 2017.
K. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
L. ASTM C476 - Standard Specification for Grout for Masonry 2023.
M. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2022.
N. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar 1992a (Reapproved 2014).
O. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2023.
P. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength 2009.
Q. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry 2019a.
R. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2020.
S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022.
T. UL (FRD) - Fire Resistance Directory Current Edition.

### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

**1.5 SUBMITTALS**

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
C. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
D. Manufacturer's Qualification Statement.
E. Installer's Qualification Statement.

**1.6 QUALITY ASSURANCE**

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
    1. Maintain one copy of each document on project site.
B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.7 DELIVERY, STORAGE, AND HANDLING**

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

**PART 2 PRODUCTS**

**2.1 CONCRETE MASONRY UNITS**

A. Concrete Block: Comply with referenced standards and as follows:
    1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
    2. Special Shapes: Provide non-standard blocks configured for bond beams.
    3. Load-Bearing Units: ASTM C90, normal weight.
        a. Hollow block, as indicated.
    4. Non-Loadbearing Units: ASTM C129.
        a. Hollow block, as indicated.
        b. Lightweight.
    5. Fire-Rated Units: Provide units meeting UL Classification as indicated on the drawings.
    6. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
        a. Performance of Units with Integral Water Repellent:
            1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
                (a) No water visible on back of wall above flashing at the end of 24 hours.
                (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.

(c) No more than 25 percent of wall area above flashing visibly damp at end of test.

2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.

3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.

4) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.

b. Use only in combination with mortar that also has integral water repellent admixture.

c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

## 2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

B. Hydrated Lime: ASTM C207, Type S.

C. Grout Aggregate: ASTM C404.

D. Water: Clean and potable.

E. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.

1. Use only in combination with masonry units manufactured with integral water repellent admixture.
2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
3. Meet or exceed performance specified for water repellent admixture used in masonry units.

F. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

1. Type: Types as scheduled in this section.
2. Color: Standard gray.
3. Water-repellent mortar for use with water-repellent masonry units.

## 2.3 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:

1. Blok-Lok Limited: www.blok-lok.com/#sle.
2. Hohmann & Barnard, Inc: www.h-b.com/#sle.
3. WIRE-BONDwww.wirebond.com/#sle.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.

C. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

## 2.4 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

1. Manufacturers:
   a. Blok-Lok Limited: www.blok-lok.com/#sle.
   b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
   c. WIRE-BOND: www.wirebond.com/#sle.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
   1. Manufacturers:
      a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
      b. WIRE-BOND: www.wirebond.com/#sle.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

**2.5 MORTAR MIXING**

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Masonry below grade and in contact with earth: Type S.
   2. Interior, loadbearing masonry: Type N.
   3. Interior, non-loadbearing masonry: Type N.

B. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

C. Mixing: Use mechanical batch mixer and comply with referenced standards.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

**3.2 PREPARATION**

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

**3.3 COLD AND HOT WEATHER REQUIREMENTS**

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

**3.4 COURSING**

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Flush.

**3.5 PLACING AND BONDING**

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

D. Remove excess mortar and mortar smears as work progresses.

E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
F. Interlock intersections and external corners.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

**3.6 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY**

A. Install horizontal joint reinforcement 8 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.

**3.7 GROUTED COMPONENTS**

A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.
B. Lap splices minimum 24 bar diameters.
C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
D. Place and consolidate grout fill without displacing reinforcing.

**3.8 CONTROL AND EXPANSION JOINTS**

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

**3.9 BUILT-IN WORK**

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.
    1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

**3.10 TOLERANCES**

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

**3.11 CUTTING AND FITTING**

A. Cut and fit for pipes and conduit. Coordinate with other sections of work to provide correct size, shape, and location.

**3.12 CLEANING**

A. Remove excess mortar and mortar droppings.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.

**3.13 PROTECTION**

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION 04 20 00**

**SECTION 05 12 00**
**STRUCTURAL STEEL FRAMING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Structural steel framing members.
B. Base plates, shear stud connectors and expansion joint plates.
C. Grouting under base plates.

### 1.2 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
B. Section 05 44 00 - Cold-Formed Steel Trusses.
C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

### 1.3 REFERENCE STANDARDS

A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges 2022.
B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges 2016.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.
E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
H. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
I. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
J. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength; 2014a.
K. ASTM A490M - Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric); 2014a.
L. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
M. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.
N. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
O. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
P. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel 2021, with Editorial Revision.
Q. ASTM A992/A992M - Standard Specification for Structural Steel Shapes 2022.

R. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.
S. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film 2017.
T. ASTM E94 - Standard Guide for Radiographic Examination 2004 (Reapproved 2010).
U. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments 2019.
V. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry 2018.
W. ASTM E709 - Standard Guide for Magnetic Particle Testing 2021.
X. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.
Y. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
Z. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series 2017a.
AA. ASTM F436 - Standard Specification for Hardened Steel Washers 2011.
BB. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners 2013.
CC. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
DD. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
EE. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
FF. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.
GG. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections 2020.
HH. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.
II. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections not detailed.
   3. Indicate cambers and loads.
   4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

## PART 2 PRODUCTS

## 2.1 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M.
B. Steel W Shapes and Tees: ASTM A992/A992M.
C. Rolled Steel Structural Shapes: ASTM A992/A992M.
D. Steel Plates and Bars: ASTM A572/A572M, Grade 50 (345) high-strength, columbium-vanadium steel.
E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
F. Hot-Formed Structural Tubing: ASTM A501/A501M, seamless or welded.
G. Pipe: ASTM A53/A53M, Grade B, Finish black.
H. Sag Rods: ASTM A36/A36M.
I. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade Aand galvanized in compliance with ASTM A153/A153M Class C.
J. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
K. High-Strength Structural Bolts: {\rs\#5} or {\rs\#2}; Type 1 alloy steel, with matching compatible {\rs\#4} or {\rs\#1} nuts and {\rs\#3} washers.
L. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
M. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
N. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi at 28 days. [CHOICE TEXT]
O. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
P. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

## 2.2 FABRICATION

A. Shop fabricate to greatest extent possible.

## 2.3 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP 2 or SP 3.
B. Shop prime structural steel members. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

## 2.4 SOURCE QUALITY CONTROL

A. Provide shop testing and analysis of structural steel.
B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least ____ percent of bolts at each connection.
C. Welded Connections: Visually inspect all shop-welded connections and test at least 25 percent of welds usingone of the following:
    1. Radiographic testing performed in accordance with ASTM E94/E94M.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.

4. Magnetic particle inspection performed in accordance with ASTM E709.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

**3.2 ERECTION**

A. Erect structural steel in compliance with AISC 303.
B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
C. Field weld components and shear studs indicated on shop drawings.
D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
E. Do not field cut or alter structural members without approval of Engineer.
F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

**3.3 TOLERANCES**

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
B. Maximum Offset From True Alignment: 1/4 inch.

**3.4 FIELD QUALITY CONTROL**

A. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least ____ percent of bolts at each connection.
B. Welded Connections: Visually inspect all field-welded connections and test at least 25 percent of welds usingone of the following:
    1. Radiographic testing performed in accordance with ASTM E94/E94M.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
    4. Magnetic particle inspection performed in accordance with ASTM E709.

**END OF SECTION 05 12 00**

**SECTION 05 21 00**
**STEEL JOIST FRAMING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
C. Supplementary framing for roof openings greater than 18 inches.

### 1.2 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking: Bearing plates and angles.
B. Section 05 31 00 - Steel Decking: Support framing for openings less than 18 inches in decking.
C. Section 05 50 00 - Metal Fabrications: Non-framing steel fabrications attached to joists.

### 1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
E. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
F. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
G. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film 2017.
H. ASTM E94 - Standard Guide for Radiographic Examination 2004 (Reapproved 2010).
I. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments 2019.
J. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry 2018.
K. ASTM E709 - Standard Guide for Magnetic Particle Testing 2021.
L. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2022.
M. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.
O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
P. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections 2020.
Q. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders 2020.
R. SJI (SPEC) - Catalog of Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders 2011.
S. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders 2008.

T. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.
U. SSPC-SP 2 - Hand Tool Cleaning 2018.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
C. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
D. Designer's Qualification Statement.
E. Fabricator's Qualification Statement.
F. Erector's Qualification Statement.

### 1.5 QUALITY ASSURANCE

A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in State of Maryland.
B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Transport, handle, store, and protect products to SJI requirements.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Steel Joists:
   1. Canam Group Inc: www.canam-steeljoists.ws
   2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.

### 2.2 MATERIALS

A. Open Web Joists: SJI Type K Joists:
   1. Provide bottom chord extensions as indicated.
   2. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard.
   3. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard.
   4. Finish: Shop primed.
B. Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.
C. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
D. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
E. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
F. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

**2.3 FABRICATION**

A. Frame special sized openings in joist web framing as detailed.
B. Space stud shear connectors on top of top chords at ____ inches on center.

**2.4 FINISH**

A. Shop prime joists as specified.
B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

**2.5 SOURCE QUALITY CONTROL**

A. Provide shop testing of steel components as follows:
B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
C. Welded Connections: Visually inspect all shop-welded connections and test at least 25 percent of welds using one of the following:
    1. Radiographic testing performed in accordance with ASTM E94.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
    4. Magnetic particle inspection performed in accordance with ASTM E709.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify existing conditions prior to beginning work.

**3.2 ERECTION**

A. Erect joists with correct bearing on supports.
B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
E. Install supplementary framing for floor and roof openings greater than 18 inches.
F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
G. Do not field cut or alter structural members without approval of joist manufacturer.

**3.3 TOLERANCES**

A. Maximum Variation From Plumb: 1/4 inch.
B. Maximum Offset From True Alignment: 1/4 inch.

**3.4 FIELD QUALITY CONTROL**

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 252 percent of bolts at each connection.
C. Welded Connections: Visually inspect all field-welded connections and test at least 25 percent of welds using one of the following:
    1. Radiographic testing performed in accordance with ASTM E94.
    2. Ultrasonic testing performed in accordance with ASTM E164.
    3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
    4. Magnetic particle inspection performed in accordance with ASTM E709.

**END OF SECTION 05 21 00**

**SECTION 05 31 00**
**STEEL DECKING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Roof deck.
B. Supplementary framing for openings up to and including 18 inches.
C. Bearing plates and angles.
D. Stud shear connectors.

### 1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Placement of anchors for bearing plates embedded in unit masonry assemblies.
B. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
C. Section 05 21 00 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.

### 1.3 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
D. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).
E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel 2018, with Errata (2022).
F. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172 2019.
G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks 2007.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
D. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
E. Certificates: Certify that products furnished meet or exceed specified requirements.
F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
G. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

### 1.5 QUALITY ASSURANCE

A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in State of Maryland.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Cut plastic wrap to encourage ventilation.
B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Steel Deck:
   1. Canam Steel Corporation: www.canam-steeljoists.ws.
   2. Cordeck, Inc: www.cordeck.com.
   3. Nucor-Vulcraft Group: www.vulcraft.com.

### 2.2 STEEL DECK

A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
   1. Calculate to structural working stress design and structural properties specified.
   2. Maximum Vertical Deflection of Roof Deck: 1/240 of span.
B. Roof Deck: Non-composite type, fluted steel sheet:
   1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
   2. Minimum Base Metal Thickness: 20 gage, 0.0359 inch.
   3. Nominal Height: 1-1/2 inch.
   4. Profile: Fluted; SDI NR.
   5. Formed Sheet Width: 36 inch.
   6. Side Joints: Lock seam.
   7. End Joints: Lapped, welded.
   8.

### 2.3 ACCESSORY MATERIALS

A. Bearing Plates and Angles: ASTM A36/A36M steelunfinished.
B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
C. Welding Materials: AWS D1.1/D1.1M.
D. Fasteners: Galvanized hardened steel, self tapping.

### 2.4 FABRICATED DECK ACCESSORIES

A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage, 0.0299 inch thick sheet steel; of profile and size as indicated; finished same as deck.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify existing conditions prior to beginning work.

### 3.2 INSTALLATION

A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
B. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches long, and as follows:
    1. Weld Diameter: 5/8 inch, nominal.
    2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of 12 inches apart, with a minimum of two welds per unit at each support.
C. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 36 inches, using one of the following methods:
    1. Mechanically fasten with self-drilling No. 10- (4.8-mm-) diameter or larger carbon steel screws.
    2. Fasten with 1-1/2-inch- (38-mm-) long minimum welds.
D. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 2 inches, with end joints as follows:
    1. End Joints: Lapped 2 inches minimum.
E. Weld deck in accordance with AWS D1.3/D1.3M.
F. At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
G. Weld stud shear connectors through steel deck to structural members below.
H. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

**END OF SECTION 05 31 00**

**SECTION 05 50 00**
**MISCELLANEOUS METALS**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Scope:
   1. Furnish labor, materials, tools, equipment, services, supervision required to complete miscellaneous metalwork including all incidental and complementary work shown, specified, or necessary to complete work as indicated.
   2. No attempt is made to enumerate each item required, but to indicate parts and describe general construction and certain special items; perform work in strict conformity with the Contract Drawings, approved Shop Drawings, and the Specifications; obtain field measurements of adjoining work required to locate and fit work.

B. Related Work specified elsewhere:
   1. Section 03 30 00 - Cast-In-Place Concrete
   2. Section 03 60 00 - Grout
   3. Section 09 90 00 - Painting
   4. Section 40 23 19 - Pipe & Pipe Fittings

### 1.2 QUALITY ASSURANCE

A. Standards:
   1. Aluminum Association (AA)
   2. American Society for Testing and Materials (ASTM):
      a. Steel Castings, Carbon, for General Application
      b. Carbon Structural Steel
      c. Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
      d. Zinc Coating (Hot-Dip) on Iron and Steel Hardware
      e. Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
      f. Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
      g. Stainless Steel Bars and Shapes
      h. Low and Intermediate Tensile Strength Carbon Steel Plates
      i. Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
      j. High-Strength Bolts for Structural Steel Joints
      k. Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements
      l. Stainless Steel Bolts, Hex Cap Screws, and Studs
   3. American Institute of Steel Construction (AISC)
   4. American Welding Society (AWS)
   5. OSHA Standards
   6. Steel Structures Painting Council (SSPC)

B. Welder, Welding Operator and Tacker Qualifications: Each welder, welding operator and tacker shall be qualified in accordance with the applicable requirements of AWS D1.1.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.
B. Shop Drawings (Miscellaneous Steel Fabrications, Pipe Bollards, and Anchor Bolts):
   1. Submit complete, detailed shop and erection drawings of all work for approval before starting fabrication and installation of materials.
   2. Show details of construction and placement including hardware, fittings and fastenings, anchorages, types and gauges of metals being used.
C. Design Drawings (Handrail Systems, Metal Stairs, Aluminum Grating, Aluminum Plate, and Vertical Ladders):
   1. Prior to fabrication, manufacturer shall submit design and erection drawings.
   2. Design drawings shall bear the seal and signature of a Professional Engineer registered in the state in which the Project is located.
D. Welder Qualifications: Submit evidence of qualifications for welders, welding operators and tackers.

**1.4 JOB CONDITIONS**

A. Field paint exposed steel in addition to shop coats and mill finishes.
B. Protect aluminum in contact with masonry or concrete with coating of bituminous paint, asphalt emulsion, zinc chromate primer, or equal.

**1.5 PRODUCT DELIVERY, HANDLING AND STORAGE**

A. Deliver all materials in good condition. Store in dry place, off ground; keep dry at all times. Handle materials to prevent damage to product or structure.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. General: Metals free from defects impairing strength, durability and appearance; best commercial quality for purposes specified, structural properties to safely withstand strains and stresses to which subjected.
B. Steel Materials:
   1. Structural Steel: ASTM A283 or A36, as applicable.
   2. Cold Finished Steel: Mild steel, rolled, drawn, ASTM A568.
   3. Steel Pipe: Black, Schedule 40, ASTM A53 as indicated on the Contract Drawings.
   4. Steel Bolts, Nuts, Washers: ASTM A307, Grade A, General Use and Grade B, Flanges galvanized in accordance with ASTM A153.
   5. High Tension Bolts: ASTM A325 Type 3 for corrosive locations.
   6. Anchor Bolts: Stainless steel, ASTM F593 or as indicated on the Contract Drawings.
C. Castings:
   1. Steel: ASTM A27, Grade 65-35, Class 1 and Class 2.
   2. Gray Iron Castings: ASTM A48, Class 30.
   3. Ductile Iron Castings: ASTM A536, Grade 60-40-18, Grade 70-50-05 for pipe fittings.
D. Stainless Steel Materials:
   1. Stainless and heat resisting steel bars and shapes: ASTM A276, Class A, Type 304.
   2. Stainless and heat resisting steel plate, sheet, strip: ASTM F593.
   3. Stainless steel bolts: ASTM A193, Type 304.

4. Stainless steel nuts: Heavy hex, ASTM A194, Type 304.

E. Gratings:
1. Metal bar grating manual for steel and aluminum gratings: ANSI/NAAMM MBG532.
2. Grating, metal, bar type: Federal Specification RR-G-661C.
3. Grating, metal, other than bar type: Federal Specification RR-G-1602.

F. Aluminum-Alloy Materials:
1. Uniform quality, free from injurious defects, and meet properties and standards of the Aluminum Association (AA).
a. Aluminum and Aluminum-Alloy Sheet and Plate: ASTM B209, Alloy 6061
b. Aluminum and Aluminum-Alloy Extruded Bars, Rods, Shapes and Tubes: ASTM B221, Alloy 6061
c. Aluminum-Alloy Extruded Structural Pipe and Tube: ASTM B429, Alloy 6063-T6
d. Aluminum-Alloy Sand Castings: ASTM B26, Alloy 356.0
e. Aluminum-Alloy Bolts, Nuts and Screws: Alloy 6061 produced from material conforming to ASTM B211
f. Aluminum-Alloy Washers: ASTM B209, Alloy Alclad 2024

## 2.2 STEEL SHOP PRIMER

A. Preparation: SSPC SP-2 and SP-1.

B. Acceptable Primers:
1. Rust Inhibitive Alkyd Resin; VOC content of unthinned product shall not exceed 2.8 lbs./gallon.
2. Products:
a. Series 88HS Azeron H.S. Primer as produced by Tnemec Company
b. Sherwin-Williams
c. Southern Coatings
d. Glidden
e. Rust-Oleum Corp.
f. Con-Lux.
g. Or equal.

C. Application:
1. Apply with spray only for metal fabrications exposed to public view.
2. Apply primer free of runs and other irregularities that may require modification to achieve the specified finish appearance.
3. Provide a minimum dry film thickness of 2 mils per coat.

## 2.3 FABRICATION

A. General:
1. Form and finish metalwork to shape and size with sharp angles and lines.
2. Metalwork that becomes bent by shearing or punching may be straightened and used if approved by the Engineer.
3. Grind exposed edges of work smooth; construct joints exposed to weather to exclude water.

B. Hardware:

1. Countersink metalwork to receive the required hardware and to provide the proper bevels and clearances.
2. Provide welded backup plates for mounting hardware; drill or punch holes for bolts and screws; conceal fastenings wherever practicable.
3. Provide brackets, lugs, and similar accessories required for installation as a part of the metal item.

C. Shop and Field Welding:
1. In accordance with recommendations of American Welding Society (AWS) Standard D1.
2. Welds solid and homogeneously a part of metals joined for full area indicated or necessary to develop required strength of joint.
3. Welds free from pits or incorporated slag or scale; surfaces of welds smooth and regular.

D. Workmanship Class 1:
1. Exposed Surfaces: Sandblast surfaces smooth with pits, mill marks, nicks and scratches filled or ground off. Defects shall not show when painted.
2. Welds: Conceal welds where possible. Where exposed, grind welds to small radius with uniform sized cove. When painted, welds shall be undetectable.
3. Bolts: Use only flat head countersunk bolts in exposed locations.
4. Straightness: Distortions visible to the eye will be rejected.
5. Joints: Fit joints to hairline finish.

E. Workmanship Class 2:
1. Exposed Surfaces: Moderate irregularities not visible at 30' may remain. Mill marks may remain.
2. Welds: Grind welds to small radius with uniform sized cove.
3. Bolts: Use only flat or oval head countersunk bolts where exposed to view.
4. Straightness: Minor distortions will be permitted.
5. Joints: Provide maximum gap of 1/16".

F. Workmanship Class 3:
1. Exposed Surfaces: No improvement from mill finish required except preparation for galvanizing or priming.
2. Welds: Grinding not required.
3. Bolts: Exposed bolts permitted.

## 2.4 GRATINGS

A. Open grating of a design, material thickness and strength to support all dead loads plus a uniform live load of 100#/sq.ft. with maximum 1/4" deflection. Minimum grating thickness shall be as indicated on the Drawings.

B. Grating shall be of the aluminum swage locked type with serrated bars for maximum slip resistance.

C. Where Drawings call for grating to have a solid cover plate, provide deck plate type grating consisting of a single piece extruded aluminum with structural ribs being an integral part of the upper surface. Design grating to support all dead loads plus a uniform live load of 100 pounds per square foot with a maximum 1/4 inch deflection. Provide a solid surface plate having a
1. 0 deep cross hatched serrations for multi-directional slip resistance and complying with Fed. Spec. 1212-G-1602-C. Provide a retractable handle on each side of each grating section to facilitate the lifting and removal of each section. Minimum grating thickness shall be as indicated on the Drawings.

D. Anchor angle frames to the supporting construction. Fabricate grating in convenient lengths for handling. Maximum allowable weight of each removable grating section is 40 pounds. Band grating along entire perimeter and at holes or other openings.
E. Grates shall be galvanized after fabrication in accordance with ASTM A123 and all hardware shall be galvanized in accordance with ASTM A153.

**2.5 PIPE RAILINGS**

A. Railing:
   1. Aluminum: Pipe railings shall be fabricated of standard 6061-T6 alloy, Schedule 40 extruded aluminum structural pipe, in accordance with ASTM B429; pipe shall be nominal 1-1/2", with 1.9" O.D. and 0.145" wall thickness.
B. Railing shall be a two-rail system designed to meet OSHA standards. Provide additional intermediate rails where indicated on the Drawings. Unless otherwise noted on the Drawings, the centerline of top rail shall be 3'-6" above walking surface and the second rail shall be installed at mid-height.
C. Provide minimum 3" clearance on single pipe stairway handrails supported on brackets from a wall.
D. Post spacing shall be adequate to meet loading requirements but shall not exceed 6'-0" o.c. maximum.
E. Railings shall be of the welded joint type or mechanical joint type. All welded connections shall be continuously filet welded and ground smooth. Mechanical joint type shall have all fasteners countersunk.
F. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.
G. Provide removable stainless steel chains with snap hooks where indicated.
H. Provide for expansion and contraction in the railing. Expansion joints must align with those in the structure to which the handrail is attached. Post spacing shall be located 1'-0" maximum to the right or left of expansion and contraction joints.
I. Railings and connections shall be capable of withstanding a uniform loading of 50 plf or a concentrated load of at least 200 pounds applied in any direction at any point on the rail.
J. Handrail post shall be base flange mounted unless otherwise noted on the Drawings.
K. Stringer connections shall be determined by stair fabricator subject to approval by the Engineer.
L. Removable Setting: Railings shall be set in close-fitting sleeves, bolted to tops or sides of concrete walls or walkways or aluminum walkway support structure as indicated on drawings.
M. Design mounting flange and anchoring system to meet the loading requirements with a minimum safety factor of 4.
N. Permanent setting shall have posts welded to base plates which in turn are bolted to the concrete with stainless steel expansion bolts on adhesive type stainless steel anchor bolts.
O. All metal railings shall be aluminum unless steel is specifically called for on the Drawings or where new railing is designed to connect to and/or match existing steel railing.
P. Finish:
   1. Aluminum: Clear anodized, AA-M21C22A41. Ship the railing plastic wrapped. Remove plastic wrap after erection.

**2.6 HANDRAIL WALL BRACKETS**

A. Provide wall brackets, where required, 4'-0" on center maximum.
B. Material:
    1. Aluminum:
        a. Wrought material the same composition as railing.

**2.7 METAL STAIRS**

A. Aluminum or steel as indicated on the Drawings.
B. Fabricate metal stairways, including stringers, stair treads, handrails, landing decks and fasteners, as indicated on the Drawings. Provide open grating non-slip stair treads for exterior stairs.
C. Shop fabricated welded or bolted installation; bolted stair treads; field cutting or burning not permitted; bolt holes drilled or punched; draw bolts tight, not protruding more than 1 thread, cut off and file smooth. All bolts and fasteners shall be stainless steel.
D. Design, fabricate and install stairs to comply with the requirements of Articles 1910.23 and 1910.24 of OSHA Standards for fixed industrial stairs, stairway railings and guards; construct
    1. stair members to support dead loads, minimum additional live loads of 125#/sq.ft., and a moving concentrated load of 1,000 pounds, without exceeding maximum permissible working stresses. Provide all intermediate support beams and vertical support members required.
    2. Submit structural drawings and calculations of stair member and platform design and anchorage system as part of the Design Drawings submittal for the stair and platform systems.

**2.8 TOE BOARDS**

A. Provide toe boards a minimum of 6" high at the following locations:
    1. Where stairs or stairways are exposed with open areas below.
    2. Where platforms, runways or catwalks crossover open areas or open tanks.
    3. Where indicated on the Drawings.
B. Toe boards shall be minimum 6" high extruded aluminum and attached to the posts with clamps or brackets which allow for lateral movement due to expansion and contraction between posts. Toe boards shall be set 1/4" above the walking surface. Notch toe boards as required at post base plates.
C. Where toe board sections terminate, splice toe board sections using a minimum 4" long bracket. The splice connection shall be a snap fit to allow expansion and contraction. Bolt, rivet, etc. type fasteners at the splice shall not be permitted. Provide a gap between the adjoining toe board sections at the splice of the dimension recommended by the manufacturer for the installation temperature.

**2.9 PIPE BOLLARDS**

A. Provide Schedule 40 black steel pipe of size and height indicated as detailed on the Drawings.
B. Permanent Setting: Set posts in concrete to a depth of 3'-0"; footing diameter minimum 3 times post diameter. Fill posts completely with concrete and dome on top.
C. Removable Setting: Close bottom of steel pipe with 8 gauge welded plate. Fill pipe with concrete. After curing, cap top of pipe with 8 gauge welded plate. Furnish sleeves for installation into concrete.
D. Bollard Sleeve: 1/4” thick polyethylene thermoplastic sleeve.
    1. Color: Safety yellow sleeve and cap.
E. Finish: Painted as specified in Section 09 90 00.

**2.10 MISCELLANEOUS STEEL FABRICATIONS**

A. Lintels:
   1. Provide steel lintels for masonry openings 18" or wider. (, except where indicated otherwise on Drawings.)
   2. Provide shop primed angles for lintels, unless otherwise indicated.
   3. For brick veneer with steel stud backup, galvanized or stainless steel lintel and shelf angles.

B. Door Guards:
   1. Provide 4" x 4" x 1/4" galvanized steel angle guards on exterior jambs, where shown on Drawings.
   2. Anchor door guard 12" on center with cinch type anchors.

**2.11 ANCHOR BOLTS**

A. Unless otherwise noted on the Drawings, furnish stainless steel anchor bolts and associated fasteners for interior and exterior applications. Anchor bolt sizing to be as shown on Drawings. Anchor bolt sizes not shown on Drawings shall be as recommended by manufacturer of equipment being anchored. Minimum anchor bolt embedment is 6 inches. Provide a minimum of 1/2" bolt projection beyond anchor bolt nut. Furnish flat washer with each anchor bolt. Unless otherwise indicated, all anchor bolts to be embedded type. Set prior to concrete placement.

B. Expansion type anchor bolts may be utilized where indicated on the Drawings. Expansion bolts shall meet the requirements above, except bolts shall have a 4" minimum embedment and conform to Federal Specification FF-S-325, Group II, Type 4, Class I for concrete expansion anchors.

**2.12 ADHESIVE ANCHORS**

A. Adhesive anchor shall consist of threaded anchor rod, nut, and washer, and two component injectable adhesive material. Anchor rods shall be stainless steel meeting AISI 304.

B. At hollow masonry and cavity wall applications also provide cylindrical wire mesh screen tube. Screen tube shall be low carbon steel with zinc electroplating manufactured with mesh size, length and diameter as specified by the adhesive manufacturer.

C. Acceptable Products:
   1. HIT HY20 by HILTI
   2. Foil-Fast by Rawl
   3. Or equal.

**2.13 ALUMINUM PLATE**

A. Aluminum checkered plate shall be 1/4" thick with diamond pattern plate, 6061-T6.

**PART 3 EXECUTION**

**3.1 PREPARATION**

A. Clean dirt, debris, oil, grease and other foreign substances from surfaces to receive metal items.

B. Where aluminum components contact concrete or lime mortar, paint surfaces with alkaline-resistant coatings such as heavy-bodied bituminous paint.

C. Dissimilar Materials: Isolate dissimilar materials to prevent electrolytic actions by neoprene gaskets, asphaltum paint or other materials.

**3.2 WORKMANSHIP**

A. General: Refer to the Drawings for items required; items require the following workmanship classes and finishes.
   1. Concealed Items: Class 3.
   2. Exposed Items in Utility Areas: Class 2.
   3. Exposed Items in Finished Areas: Class 1.
   4. Steel Items Subject to Contact with Moisture: Galvanized finish.
   5. Steel Items not Subject to Contact with Moisture: Primed finish.

B. Details and connections shall be carefully made and fitted, with special care exercised to produce a thoroughly neat appearance; make pieces in accordance with detail shop drawings; members shall be true to length so assembling may be done without fillers, except where required by details; allow no projecting edges or corners where different members are assembled; do mitering and blocking precisely.

C. Set built-up parts true to line and without sharp bends, twists or kinks.

**3.3 BURNING AND WELDING**

A. Burning: Burning of holes in field shall not be permitted without consent; if consent is given, burned members shall be finished to an appearance equal to sheared finish; burning shapes to length with standard flame-cutting machine will be permitted.

B. Perform both shop and field welding in accordance with recommendations of American Welding Society. Welds shall be solid and homogeneously a part of metals joined, free from pits or incorporated slag or scale; surfaces of welds shall be smooth and regular, of full area indicated or necessary to develop required strength of joint.

**3.4 INSTALLATION**

A. Erect work to lines and levels, plumb and true, in correct relation to adjoining work; secure parts in rigid, durable manner. Provide concealed connections wherever possible.

B. Provide anchors and inserts in sufficient number for proper fastening of metal items; embed anchors in concrete so as to accurately align metalwork at proper level.

C. Built-in Anchors: Provide strap iron anchors welded to steel or iron frames or miscellaneous member for attaching to concrete or masonry.
   1. Minimum Anchor Size: 1-1/2" wide x length required to embed 2" into substrate.
   2. Minimum Anchor Thickness:
      a. Concrete Substrates: 1/4".
      b. Masonry Substrates: 1/8".
   3. Maximum Anchor Spacing:
      a. Concrete Substrates: 32" on center, unless noted otherwise.
      b. Masonry Substrates: 32" on center; match joint locations.

D. Anchors not Built-in: Provide cinch type anchors with machine bolts or screws, where built-in anchors cannot be used.

E. Where necessary to secure miscellaneous metalwork to structure by means of expansion bolts, cinch anchors and similar connections, do work of laying out, installing such connections, installing miscellaneous work, and bolting up.

F. Throughout work, provide anchors, inserts wherever possible for building adjoining work; where lugs are shown or specified for building into adjoining masonry, erect parts having lugs before masonry is built; elsewhere, bring work to building in as large pieces as practicable, attach to anchors or inserts during erection.

G. Connections made to sleeve inserts, except where noted removable, install members into sleeves, wedged tight with metal wedges; pour surrounding space full of expanding grout; caulk to finish flush with adjoining surface.

**3.5 RAILINGS AND WALL BRACKETS**

A. Railing and Wall Bracket shall be fabricated and installed to withstand a 200 lb. point load applied in any direction per OSHA requirement.

B. Removable Setting: Railings shall be set in close-fitting sleeves; sleeves set in concrete; sleeves shall be 1" less in length than thickness of concrete. Weld 3" flanges to posts at floor level.

C. Bolted Setting: Flanges shall be 3" and welded to bottom of posts; flanges bolted to floor with expansion type fasteners.

D. Permanent Setting:

1. Concrete: Set posts in sleeves, and securely wedge and grout (expanding/non-shrink) in place; sleeves shall be 1" less in length than thickness of slab.

**3.6 CONNECTIONS**

A. Unless otherwise specified, all shop connections shall be welded or riveted; framing connections made in field shall be made with high tension steel bolts; other connections may be made by any of the above methods, or with standard strength bolts.

B. All connections shall develop strength required for members involved; in no case less than AISC standard.

C. Provide lugs, clips, connections, rivets, bolts, necessary for complete fabrication, erection; bolts remaining in finished, exposed work shall be hexagon head bolts with hexagon nuts; bolts shall be of proper length to permit full thread in nut, but not project more than 1/4" beyond face of nut. Rivets, both shop and field, power driven; shall provide 100 lbs. per sq. in. at hammer minimum.

D. High Tension Steel Bolts: Furnish and install in accordance with ”Specification for Structural Joints using ASTM A325 or A490 Bolts” of AISC, as amended to date.

**3.7 FIELD PAINTING**

A. Where shop coat is abraded or burned by welding, clean and touch-up.

B. Repair surfaces of zinc coating that have been damaged during delivery, storage or installation by thoroughly wire brushing the damaged areas and removing all loose and cracked zinc coating, then paint the cleaned areas with 2 coats of zinc-dust, zinc-oxide primer; touch-up zinc-dust coated surfaces with the same material as the coating.

C. Field paint in accordance with the requirements of Section 09 90 00.

**3.8 CLEAN UP**

A. All work shall be left in clean condition, and all debris and rubbish cleaned up and removed from site by Contractor.

**END OF SECTION 05 50 00**

**SECTION 06 10 00**
**ROUGH CARPENTRY**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Roofing nailers.
C. Roofing cant strips.
D. Preservative treated wood materials.
E. Miscellaneous framing and sheathing.
F. Communications and electrical room mounting boards.
G. Concealed wood blocking, nailers, and supports.
H. Miscellaneous wood nailers, furring, and grounds.

### 1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
B. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
C. Section 07 41 13 - Metal Roof and Wall Panels.

### 1.3 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings 2018, with Errata (2019).
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings 2018, with Errata (2019).
E. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.
F. PS 1 - Structural Plywood 2019.
G. PS 2 - Performance Standard for Wood Structural Panels 2018.
H. PS 20 - American Softwood Lumber Standard 2021.
I. SPIB (GR) - Standard Grading Rules 2021.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide technical data on wood preservative materials.
C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

## PART 2 PRODUCTS

## 2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
   2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. Lumber fabricated from old growth timber is not permitted.

## 2.2 DIMENSION LUMBER

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).
B. Sizes: Nominal sizes as indicated on drawings, S4S.
C. Moisture Content: S-dry or MC19.
D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

## 2.3 EXPOSED TIMBERS

A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
B. Moisture Content: Kiln-dry (20 percent maximum).
C. Surfacing: S4S.
D. Species: Douglas Fir.
E. Grade: No. 2.

## 2.4 CONSTRUCTION PANELS

A. Roof Sheathing: Plywood PS 1 type, rated Structural I Sheathing.
   1. Bond Classification: Exterior.
   2. Span Rating: 24.
   3. Performance Category: 7/16 PERF CAT.
B. Wall Sheathing: Plywood, PS 1, Grade C-C Exterior Exposure.
C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

## 2.5 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Anchors: As required for substrate..
B. Water-Resistive Barrier: No. 15 asphalt felt where indicated on drawin`Building Paper: Water resistant Kraft paper.

## 2.6 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:
   1. Manufacturers:
      a. Lonza Group : www.wolmanizedwood.com/#sle.
      b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
      c. Viance, LLC: www.treatedwood.com.
      d. Osmose, Inc: www.osmose.com.
   2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with roofing, flashing, or waterproofing.
      d. Treat lumber in contact with masonry or concrete.
      e. Treat lumber less than 18 inches above grade.
      f. Treat lumber in other locations as indicated.
   3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      b. Treat plywood in contact with roofing, flashing, or waterproofing.
      c. Treat plywood in contact with masonry or concrete.
      d. Treat plywood less than 18 inches above grade.
      e. Treat plywood in other locations as indicated.

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.
B. Coordinate installation of rough carpentry members specified in other sections.

### 3.2 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### 3.3 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices unless otherwise specifically detailed.
D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
E. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.

**3.4 BLOCKING, NAILERS, AND SUPPORTS**

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

**3.5 ROOF-RELATED CARPENTRY**

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide prefabricated curbs at all roof openings.

**3.6 INSTALLATION OF CONSTRUCTION PANELS**

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
    1. Nail panels to framing; staples are not permitted.
B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
    1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
    2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
    3. Install adjacent boards without gaps.

**3.7 SITE APPLIED WOOD TREATMENT**

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
B. Allow preservative to dry prior to erecting members.

**3.8 TOLERANCES**

A. Framing Members: 1/4 inch from true position, maximum.
B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

**3.9 CLEANING**

A. Waste Disposal:.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION 06 10 00**

**SECTION 06 17 53**
**SHOP-FABRICATED WOOD TRUSSES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Shop fabricated wood trusses for roof framing.
B. Bridging, bracing, and anchorage.
C. Preservative treatment of wood.

### 1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Installation requirements for miscellaneous framing.

### 1.3 REFERENCE STANDARDS

A. ANSI/TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction 2014.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
C. SPIB (GR) - Standard Grading Rules 2021.
D. TPI 1 - National Design Standard for Metal-Plate-Connected Wood Truss Construction 2014.
E. TPI BCSI 1 - Building Component Safety Information Booklet: The Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses 2018.
F. TPI DSB-89 - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses 1989.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on plate connectors, bearing plates, and metal bracing components.
C. Shop Drawings: Show truss configurations, sizes, spacing, size and type of plate connectors, cambers, framed openings, bearing and anchor details, and bridging and bracing.
    1. Include identification of engineering software used for design.
    2. Provide shop drawings stamped or sealed by design engineer.
    3. Submit design calculations.

### 1.5 QUALITY ASSURANCE

A. Designer Qualifications: Perform design by or under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in State of Maryland.
B. Fabricator Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and erect trusses in accordance with TPI BCSI 1.
B. Store trusses in vertical position resting on bearing ends.

## PART 2 PRODUCTS

**2.1 MANUFACTURERS**

A. Truss Plate Connectors:
   1. Alpine, an ITW Company: www.alpineitw.com/#sle.
   2. MiTek Industries, Inc: www.mii.com/#sle.
   3. Truswal Systems: www.truswal.com.

**2.2 TRUSSES**

A. Wood Trusses: Designed and fabricated in accordance with TPI 1 and TPI DSB-89 to achieve structural requirements indicated.
   1. Species and Grade: Southern Pine, SPIB (GR) Grade 2.
   2. Connectors: Steel plate.
   3. Structural Design: Comply with applicable code for structural loading criteria.
   4. Roof Deflection: 1/240, maximum.

**2.3 MATERIALS**

A. Lumber:
   1. Moisture Content: Between 7 and 9 percent.
   2. Lumber fabricated from old growth timber is not permitted.
B. Steel Connectors: Hot-dipped galvanized steel sheet, ASTM A653/A653M Structural Steel (SS) Grade 33/230, with G90/Z275 coating; die stamped with integral teeth; thickness as indicated.
C. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

**2.4 ACCESSORIES**

A. Wood Blocking, Bridging, Plates, and Miscellaneous Framing: Softwood lumber, any species, construction grade, 19 percent maximum and 7 percent minimum moisture content.
B. Fasteners: Electrogalvanized steel, type to suit application.

**2.5 WOOD TREATMENT**

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that field measurements are as indicated.
B. Verify that supports and openings are ready to receive trusses.

**3.2 PREPARATION**

A. Coordinate placement of bearing items.

**3.3 ERECTION**

A. Install trusses in accordance with manufacturer's instructions and TPI DSB-89 and TPI BCSI 1; maintain a copy of each TPI document on site until installation is complete.
B. Set members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.
D. Do not field cut or alter structural members without approval of Engineer.
E. Install permanent bridging and bracing.
F. Install headers and supports to frame openings required.
G. Frame openings between trusses with lumber in accordance with Section 06 10 00.
H. Coordinate placement of decking with work of this section.

**3.4 TOLERANCES**

A. Framing Members: 1/2 inch maximum, from true position.

**END OF SECTION 06 17 53**

**SECTION 06 60 00**
**PLASTIC FABRICATIONS**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:
   1. Fiberglass Grating
B. Related Work specified elsewhere:
   1. Section 03 30 00 - Cast-In-Place Concrete
   2. Section 05 50 00 - Miscellaneous Metals
   3. Section 40 23 19 - Pipe and Pipe Fittings

### 1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. D3299 - Filament-Wound Glass-Fiber Reinforced Polyester Chemical-Resistant Tanks.
      b. D3918 - Reinforced Plastic Pultruded Products, Specifications and Definition of Terms.
      c. D635 - Test Method for Rate of Burning and/or Extent and Time of Burning Self-supporting Plastics in a Horizontal Position.
      d. E84 - Test Method for Surface Burning Characteristics of Building Materials.
      e. Occupational Safety and Health Administration (OSHA)
B. All fiberglass materials shall contain sufficient resin to ensure a relatively smooth surface free from exposed glass fibers or sharp projections, and shall contain an ultraviolet inhibiting agent.

### 1.3 SUBMITTALS

A. Shop Drawings and Product Data: Submit manufacturer's product data and shop drawings for all products specified herein.
B. Drawings and calculations submitted for products listed under paragraph 1.4 shall be sealed by a professional engineer registered in the Commonwealth of Pennsylvania.
C. Certificates: Submit certification from each product manufacturer attesting that the product meets or exceeds specification requirements.

### 1.4 DESIGN CONDITIONS

A. Grating (Molded):
   1. Design for 50 psf live load.
   2. Maximum deflection 1/360 of span.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Fiberglass reinforced polyester plastic molded to produce uniform, smooth surfaces free of voids and porosity, free of dry spots, crazes, or unreinforced areas; corrosion and weathering resistant.
B. Resin seal all plastic material edges that are machined or cut during the manufacturing of the product.
C. Provide plastic fabrications with stainless steel hardware.

**2.2 GRATING (MOLDED)**

A. One-piece molded construction using thermosetting resin, fire retardant polyester, Class 1 and continuous glass fiber reinforcement with glass content not to exceed 35 percent of the composite.
B. A halogenated polyester resin system shall be used to achieve Class 1 properties without chemically degrading fillers.
C. Thermosetting resin shall be type standard grade, corrosion resistant isophtalic polyester system.
D. Grating shall meet or exceed ASTM E-84, 25 maximum and be self-extinguishing in accordance with ASTM D-635.

**PART 3 EXECUTION**

**3.1 CONSTRUCTION**

A. Grating (Molded):
    1. Maximum bar center to center spacing shall be 1-3/4".
    2. Grating shall be 1-1/2" x 1-1/2" nominal square mesh pattern.

**3.2 INSTALLATION**

A. Each piece, part or unit shall be tagged with the manufacturer's drawing and part numbers for ease of field installation.

**END OF SECTION 06 60 00**

**SECTION 07 13 00**
**SHEET WATERPROOFING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Sheet membrane waterproofing.
B. Below-grade waterproofing accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.

### 1.3 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers- Tension; 2006a (Reapproved 2013).
B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).
E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008,
F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
G. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).
H. ASTM E96/E96M - Standard Test Methods For Water Vapor Transmission of Materials; 2014.
I. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for membrane.
C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
D. Certificate: Certify that products meet or exceed specified requirements.
E. Manufacturer's Installation Instructions: Indicate special procedures.
F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### 1.5 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with five years experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.

### 1.6 MOCK-UP

A. Construct mock-up 100 sq ft of horizontal waterproofed panel; to represent finished work including internal and external corners.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

### 1.7 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

### 1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

## PART 2 PRODUCTS

### 2.1 WATERPROOFING APPLICATIONS

A. Self-Adhered Modified Bituminous Sheet Waterproofing: Use at foundation walls.
    1. Cover with protection board.

### 2.2 MEMBRANE MATERIALS

A. Basis of Design Manufacturer: Bituthane System 4000 by Grace Construction Products: www.na.graceconstruction.com; or comparable product meeting project requirements by one of the following:
    1. Carlisle Coatings & Waterproofing Incorporated: www.carlisle-ccw.com.
    2. Henry Company: www.henry.com.
    3. W.R. Meadows, Inc: www.wrmeadows.com.
B. Self-Adhered Modified Bituminous Membrane:
    1. Thickness: 60 mil (0.060 inch).
    2. Sheet Width: 36 inches.
    3. Tensile Strength:
        a. Film: 5000 pounds per square inch, minimum, measured according to ASTM D882 and at grip-separation rate of 2 inches per minute.
        b. Membrane: 325 pounds per square inch, minimum, measured according to ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
    4. Elongation at Break: 300 percent, minimum, measured according to ASTM D412.
    5. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
    6. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
    7. Peel Strength: 9 pounds per inch, minimum, when tested according to ASTM D903.
    8. Lap Adhesion Strength: 5 pounds per inch, minimum, when tested according to ASTM D1876.
    9. Puncture Resistance: 50 pounds, minimum, measured in accordance with ASTM E154/E154M.

10. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
11. Hydrostatic Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
12. Adhesives, Sealants, Tapes, Surface Conditioners and Accessories: As recommended by membrane manufacturer.

C. Seaming Materials: As recommended by membrane manufacturer.
D. Membrane Sealant: As recommended by membrane manufacturer.
E. Surface Conditioner: Membrane manufacturer's required type, for installed application.

**2.3 ACCESSORIES**

A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
B. Prefabricated Drainage Composite: Basis of Design - Hydoduct 220, by Grace Construction Products: www.na.graceconstruction.com; or comparable product meeting project requirements by one of the following:
    1. Carlisle Coatings & Waterproofing Incorporated: www.carlisle-ccw.com.
    2. Henry Company: www.henry.com.
    3. W.R. Meadows, Inc.: www.wrmeadows.com.
C. Protection Board: Type capable of preventing damage to waterproofing due to backfilling and construction traffic.
    1. Expanded Polystyrene Protection Board: 25 mm (1 in.) thick for vertical applications with the following characteristics. Adhere to waterproofing membrane with membrane manufacturer's protection board adhesive or approved equal.
        a. Normal Density: 16 kg/m3 (1.0 lb/ft3)
        b. Thermal Conductivity, K factor: 0.24 at 5°C (40°F), 0.26 at 24°C (75°F)
        c. Thermal Resistance, R-Value: 4 per 25 mm (1 in.) of thickness.
D. Miscellaneous Materials: Surface conditioner, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify existing conditions before starting work.
B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
C. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

**3.2 PREPARATION**

A. Protect adjacent surfaces not designated to receive waterproofing.
B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Vacuum substrate clean.
C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.

E. Seal moving cracks with sealant, not rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
F. Seal cracks and joints with sealant using depth to width ratio as recommended by sealant manufacturer.
G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

**3.3 INSTALLATION - MEMBRANE**

A. Install membrane waterproofing in accordance with manufacturer's instructions.
B. Roll out membrane. Minimize wrinkles and bubbles.
C. Self-Adhering Membrane: Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.
D. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
G. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
H. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

**3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD**

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
C. Adhere protection board to substrate with compatible adhesive.

**3.5 PROTECTION**

A. Do not permit traffic over unprotected or uncovered membrane.

**END OF SECTION 07 13 00**

**SECTION 07 21 00**
**THERMAL INSULATION**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Board insulation at perimeter foundation wall and underside of floor slabs.

### 1.2 RELATED REQUIREMENTS

### 1.3 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2022.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's Installation Instructions: Include information on installation techniques.

### 1.5 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

## PART 2 PRODUCTS

### 2.1 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

### 2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
    1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
    2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
    3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
    4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
    5. R-value; 1 inch of material at 72 degrees F: 5, minimum.
    6. Board Size: 48 x 96 inch.
    7. Board Thickness: 2 inches.
    8. Board Edges: Square.
    9. Water Absorption, Maximum: 0.10 percent, by volume.
    10. Manufacturers:
        a. Dow Chemical Co: www.dow.com.
        b. Owens Corning Corp: www.owenscorning.com.
        c. Kingspan Insulation LLC; <>: www.trustgreenguard.com.

d. or equal.

**2.3 ACCESSORIES**

A. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.
B. Adhesive: Type recommended by insulation manufacturer for application.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

**3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER**

A. Adhere a 6 inch wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.
B. Apply adhesive to back of boards:
   1. Three continuous beads per board length as recommended by insulation manufacturer for application.
   2. Full bed 1/8 inch thick, as recommended by insulation manufacturer for application.
C. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Butt edges and ends tightly to adjacent boards and to protrusions.
D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

**3.3 BOARD INSTALLATION UNDER CONCRETE SLABS**

A. Place insulation under slabs on grade after base for slab has been compacted.
B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

**3.4 PROTECTION**

A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 21 00**

**SECTION 07 25 00**
**WEATHER BARRIERS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
B. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.

### 1.2 RELATED REQUIREMENTS

A. Section 04 27 13 - Cavity Wall and Unit Masonry: Vapor retarder installed in conjunction with insulation.
B. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with insulation.
C. Section 07 62 00 - SHEET METAL FLASHING AND TRIM: Metal flashings installed in conjunction with weather barriers.

### 1.3 DEFINITIONS

A. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.
B. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

### 1.4 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
B. AATCC Test Method 30 - Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials; 2013.
C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2009.
D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
E. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2000 (Reapproved 2010)e1.
F. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials; 2014.

### 1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on material characteristics.
C. Manufacturer's Installation Instructions: Indicate preparation.

### 1.6 MOCK-UP

A. Install vapor retarder materials in mock-up specified in Section 04 27 23 Cavity Wall and Unit Masonry.

**1.7 FIELD CONDITIONS**

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

**PART 2 PRODUCTS**

**2.1 WEATHER BARRIER ASSEMBLIES**

A. Water-Resistive Barrier: Provide on where indicated on Drawings.
   1. Use asphalt felt unless otherwise indicated.
B. Exterior Vapor Retarder:
   1. On outside surface of inside wythe of masonry cavity wall use vapor retarder coating.

**2.2 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER NOR VAPOR**

A. RETARDER)
B. Asphalt Felt: ASTM D226 Type I felt (No.15).

**2.3 VAPOR RETARDER MATERIALS (AIR / MOISTURE BARRIER)**

A. Vapor Retarder Coating: Liquid applied, resilient, UV-resistant coating and associated joint treatment.
   1. Dry Film Thickness: 5 mils (0.005 inch), minimum.
   2. Water Vapor Permeance: 1.0 perm, maximum, when tested in accordance with ASTM E96/E96M.
   3. VOC Content: Less than 50 g per L when tested in accordance with 40 CFR 59 Subpart D (EPA Method 24).
   4. Resistance to Fungal Growth: No growth when tested according to ASTM D5590.
   5. Code Acceptance: Comply with applicable requirements of ICC-ES Acceptance Criteria
      a. AC 212.
   6. Suitable for use on concrete, masonry, plywood and gypsum sheathing.
   7. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
   8. Products:
      a. Carlisle Coatings and Waterproofing, Inc.; Product: Barriseal-S; www.carlisle-ccw.com.
      b. Epro Services, Inc.; ECOFLEX-S: www.eproserv.com.
      c. Henry Company; Air-Bloc 32MR: www.henry.com.
      d. LATICRETE International, Inc.; LATICRETE Air and Water Barrier with LATICRETE Waterproofing/Anti-Fracture Fabric: www.laticrete.com.
      e. R. Meadows, Inc.; Air-Shield LM or Air-Shield LM (All Season): www.wrmeadows.com.
      f. Or equal.
   9. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

**2.4 ACCESSORIES**

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
   1. Thinners and Cleaners: As recommended by material manufacturer. PART 3 EXECUTION

**2.5 EXAMINATION**

A. Verify that surfaces and conditions are ready to accept the work of this section.

**2.6 PREPARATION**

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Clean and prime substrate surfaces to receive coatings in accordance with manufacturer's instructions.

**2.7 INSTALLATION**

A. Install materials in accordance with manufacturer's instructions.
B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
E. Mechanically Fastened Sheets - On Exterior:
    1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
    2. Overlap seams as recommended by manufacturer but at least 6 inches.
    3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
    4. Install water-resistive barrier over jamb flashings.
    5. Install air barrier and vapor retarder UNDER jamb flashings.
    6. Install head flashings under weather barrier.
    7. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
F. Coatings:
    1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
    2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.
    3. Use flashing to seal to adjacent construction and to bridge joints.

**2.8 FIELD QUALITY CONTROL**

A. Do not cover installed weather barriers until required inspections have been completed.
B. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.

**2.9 PROTECTION**

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION 07 25 00**

**SECTION 07 42 13.19**
**INSULATED METAL WALL PANELS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Factory-assembled metal panel system for walls, with trim, related flashings and accessory components.
B. Secondary sub-girt framing system, attached to building structural frame.

### 1.2 RELATED REQUIREMENTS

A. Section 04 20 00: Substrate surface.
B. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
C. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

### 1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).

### 1.4 PRE-INSTALLATION MEETING

A. Preinstallation Meeting: Convene one week before starting work of this section.

### 1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer documentation on tested structural and thermal capabilities of assembled panel.
C. Shop Drawings: Indicate dimensions.
D. Samples: Submit two samples of panel, 12 x 12 inch in size illustrating finish color, sheen, and texture.
E. Manufacturer's Installation Instructions: Indicate special handling criteria.

### 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
B. Installer Qualifications: Company specializing in performing the work of this Section with minimum three years experience and approved by manufacturer.

### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
B. Store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
C. Prevent contact with materials that could cause discoloration or staining.

### 1.8 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
B. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for insulated metal wall panels.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design: Nucor Building Systems " AWI DM40 - Double Mesa" insulated wall panel, www.nucorbuildingsystems.com or comparable products meeting project spsecifications by one of the following.
B. Other Acceptable Manufacturers: Insulated Metal Wall Panels:
   1. ATAS International, Inc: www.atas.com/#sle.
   2. Metl-Span, a Division of NCI Group, Inc: www.metlspan.com/#sle.
   3. MBCI: www.mbci.com/#sle.

### 2.2 PANEL SYSTEM

A. Metal Panel System: Factory-assembled metal panel system, with trim, related flashings and accessory components.
   1. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
   2. Accommodate tolerances of building structural framing.
B. Performance Requirements:
   1. Thermal Performance: Provide thermal resistance through entire system; R-value R-24 of ____ deg F hr sq ft/Btu, minimum.
   2. Structural Performance: Design and size to withstand all dead loads and wind loads caused by positive and negative wind pressure acting normal to plane of panel.
      a. Verify structural performance in accordance with ASTM E330/E330M, using test pressure 1.5 times design wind pressure, with 10 seconds duration of maximum load.
   3. Movement: Accommodate the movement caused by the following without damage to system, components, or deterioration of seals:
      a. Normal movement between system components.
      b. Seasonal temperature cycling.
      c. Deflection of structural support framing,

### 2.3 PANELS AND TRIM

A. Wall Panels: Exterior and interior metal sheet skin, factory-assembled, with foamed in place insulation; exterior and interior sheet interlocking at edges, fitted with continuous gaskets.
   1. Panel Width: 40 inch.
   2. Profile: Mesa; vertical panels.
   3. Panel Thickness: 3 inch.
   4. Exterior Sheet: Pre-finished galvanized steel, 24 gage, 0.0250 inch minimum base metal thickness; lightly embossed finish.

5. Interior Sheet: Galvanized steel, pre-finished, 24 gage, 0.0250 inch minimum base metal thickness; lightly embossed finish.
6. Panel Edge Profile: Tongue and groove, for flush seam.
7. Fabricate panels in longest practicable lengths.

B. Internal and External Corners: Same material, thickness, and finish as exterior sheets; factory-fabricated mitered to required angles in one continuous piece with minimum 6 inch returns.

C. Trim, Closure Pieces, Expansion Joints, and Flashings: Same material , thickness and finish as exterior sheets; factory-fabricated to required profiles; fabricated in longest practicable lengths.
1. Thickness: 26 gage, 0.0187 inch.
2. Exposed Fasteners: Same finish as panel system.
3. Profiles: To suit system.

**2.4 PANEL MATERIALS**

A. Precoated Galvanized Steel Sheet: ASTM A653/A653M, Commercial Steel (CS) or Forming Steel (FS), with G90/Z275 coating; continuous-coil-coated with acrylic primer coat, silicone polyester top coat, and polyester washcoat for panel back.
1. Color of Exposed Exterior Surfaces: As selected by Engineer from manufacturer's standard range.

B. Foamed-in-Place Insulation: Urethane type.

C. Gaskets: Manufacturer's standard type suitable for use with panel system, permanently resilient; ultraviolet and ozone resistant; color as selected by Architect.

D. Panel Sealants: Manufacturer's standard type suitable for use with installation of panel system; non-staining, skinning, non-shrinking, non-sagging, ultra-violet and ozone resistant; <> color as selected by Engineer.

**2.5 ACCESSORIES**

A. Concealed Sealants: Non-curing butyl sealant or tape sealant.

B. Exposed Sealants: Elastomeric; silicone.

C. Subgirts: As indicated on drawings and as required for system design.

D. Anchors: Stainless steel.

E. Field Touch-up Paint: As recommended by panel manufacturer.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that structural framing is ready to receive panel system.

**3.2 INSTALLATION**

A. Install panel system on walls in accordance with manufacturer's instructions.

B. Protect panel surfaces in contact with cementitious materials with bituminous paint. Allow to dry prior to installation.

C. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.

D. Locate panel joints over supports.

E. Use concealed fasteners unless otherwise approved by Engineer.

F. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

**3.3 TOLERANCES**

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

**3.4 CLEANING**

A. Remove site cuttings from finish surfaces.

B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

**END OF SECTION 07 42 13.19**

**SECTION 07 54 23**
**THERMOPLASTIC-POLYOLEFIN ROOFING (TPO)**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Thermoplastic membrane roofing system, including all components specified.
B. Comply with the published recommendations and instructions of the roofing membrane manufacturer.
C. Commencement of work by Contractor shall constitute acknowledgement by Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

### 1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood nailers associated with roofing and roof insulation.
B. Section 07 42 13.19 - Insulated Metal Wall Panels.

### 1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 for definition of terms related to roofing work not otherwise defined in the section.

### 1.4 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
B. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
C. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting; 2013.
D. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2013.
E. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing; 2013.
F. PS 1 - Structural Plywood; 2009.
G. PS 20 - American Softwood Lumber Standard; 2010.
H. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2011. (ANSI/SPRI/FM 4435/ES-1)

### 1.5 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference: Before start of roofing work, Contractor shall hold a meeting to discuss the proper installation of materials and requirements to achieve the warranty.
    1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.
    2. Notify Engineer well in advance of meeting.

### 1.6 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data:
   1. Provide membrane manufacturer's printed data sufficient to show that all components of roofing system, including insulation and fasteners, comply with the specified requirements and with the membrane manufacturer's requirements and recommendations for the system type specified; include data for each product used in conjunction with roofing membrane.
   2. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show exactly how all components will be installed; where instructions allow installation options, clearly indicate which option will be used.
C. Samples: Submit samples of each product to be used.
D. Shop Drawings: Provide:
   1. The roof membrane manufacturer's standard details customized for this project for all relevant conditions, including flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
   2. For tapered insulation, provide project-specific layout and dimensions for each board.
E. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications.
F. Executed Warranty.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: Roofing installer shall have the following:
   1. Current Firestone Red Shield Licensed Contractor status.
   2. Current approval, license, or authorization as applicator by the manufacturer.
   3. Fully staffed office within 100 miles of the job site.
   4. At least five years experience in installing specified system.

## 1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
B. Store materials clear of ground and moisture with weather protective covering.
C. Keep combustible materials away from ignition sources.

## 1.9 WARRANTY

A. See Section 01 70 00 - Project Closeout, for additional warranty requirements.
B. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
C. Warranty: Firestone Limited Warranty covering membrane, roof insulation, and other indicated components of the system, for the term indicated.
   1. Limit of Liability: No dollar limitation.
   2. Scope of Coverage: Repair leaks in the roofing system caused by:
      a. Ordinary wear and tear of the elements.
      b. Manufacturing defect in Firestone brand materials.
      c. Defective workmanship used to install these materials.
      d. Damage due to winds up to 90 mph.

3. Not Covered:
    a. Damage due to winds in excess of 90 mph.
    b. Damage due hurricanes or tornadoes.
    c. Intentional damage.
    d. Unintentional damage due to normal rooftop inspections, maintenance, or service.

D. Insulation Warranty: Separate Firestone ISO 95+ Insulation Warranty with warranty term coinciding with Red Shield Warranty.
    1. Limit of Liability: No dollar limitation
    2. Scope of Coverage: Provide replacement for insulation that warps, bows, or is on the point of causing a roof leak as a result of manufacturing defect.

E. Metal Roof Edging: Firestone full-system warranty for roof edge system, covering blow-off from winds up to 90 mph.

F. Metal Roof Edging with Exposed Decorative Fascia: Provide 20 year warranty for painted finish covering color fade, chalk, and film integrity.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

A. Basis of Design Manufacturer - Roofing System: Firestone Building Products LLC, Carmel, IN: www.firestonebpco.com.
    1. Roofing systems manufactured by others are acceptable provided the roofing system is completely equivalent in materials and warranty conditions and the manufacturer meets the following qualifications:
        a. Specializing in manufacturing the roofing system to be provided.
        b. Roofing systems manufactured by the companies listed below are acceptable provided they are completely equivalent in materials and warranty conditions:
            1) Carlisle, Syntec Systems; www.carlislesyntec.com.
            2) John Manville; www.jm.com.
            3) Versico Roofing Systems; www.versico.com.
            4) Or equal.

B. Manufacturer of Insulation: Same manufacturer as roof membrane.

C. Manufacturer of Metal Roof Edging: Same manufacturer as roof membrane.
    1. Factory fabricated products by other manufacturers are acceptable provided they are completely equivalent in materials and performance and approved by membrane roofing manufacturer.

**2.2 ROOFING SYSTEM DESCRIPTION**

A. Basis of Design Roofing System: "UltraPly" by Firestone Building Products, thermoplastic olefin (TPO) single-ply membrane.
    1. Membrane Attachment: Fully adhered.
    2. Warranty: Full system warranty; Firestone 20 year Red Shield Limited Warranty covering membrane, roof insulation, and membrane accessories.
    3. Comply with applicable local building code requirements.

B. Roofing System Components: Listed in order from the top of the roof down:

1. Membrane: Thickness as specified.
2. Insulation:
    a. Maximum Board Thickness: 2 inches; use as many layers as necessary; stagger joints in adjacent layers.
    b. Tapered: Slope as indicated; provide minimum R-value at thinnest point; place tapered layer on top, cold adhesive attached.
    c. Total R-value of 30, minimum.
    d. Top Layer: Polyisocyanurate tapered foam board, non-composite; cold adhesive attached.
    e. Bottom Layer: Polyisocyanurate foam board, non-composite; cold adhesive attached.
    f. Crickets: Tapered insulation of same type as specified for top layer; slope as indicated, cold adhesive attached.

**2.3 MEMBRANE MATERIALS**

A. Membrane: Flexible, heat weldable sheet composed of thermoplastic polyolefin polymer and ethylene propylene rubber; complying with ASTM D6878/D6878M, with polyester weft inserted reinforcement and the following additional characteristics:
    1. Thickness: 0.060 inch plus/minus 10 percent, with coating thickness over reinforcement of 0.024 inch plus/minus 10 percent.
    2. Puncture Resistance: 265 lbf, minimum, when tested in accordance FTM 101C Method 2031.
    3. Color: Tan.
    4. Acceptable Product: UltraPly TPO by Firestone.
B. Curb and Parapet Flashing: Same material as membrane, with encapsulated edge which eliminates need for seam sealing the flashing-to-roof splice; precut to 18 inches wide.
C. Formable Flashing: Non-reinforced, flexible, heat weldable sheet, composed of thermoplastic polyolefin polymer and ethylene propylene rubber.
    1. Thickness: 0.060 inch plus/minus 10 percent.
    2. Tensile Strength: 1550 psi, minimum, when tested in accordance with ASTM D638 after heat aging.
    3. Elongation at Break: 650 percent, minimum, when tested in accordance with ASTM D638 after heat aging.
    4. Tearing Strength: 12 lbf, minimum, when tested in accordance with ASTM D1004 after heat aging.
    5. Color: White.
    6. Acceptable Product: UltraPly TPO Flashing by Firestone.
D. Tape Flashing: 5-1/2 inch nominal wide TPO membrane laminated to cured rubber polymer seaming tape, overall thickness 0.065 inch nominal; TPO QuickSeam Flashing by Firestone.
E. Bonding Adhesive: Neoprene and SBR rubber blend, formulated for compatibility with the membrane other substrate materials, including masonry, wood, and insulation facings; UltraPly Bonding Adhesive by Firestone.
F. Pourable Sealer: Two-part polyurethane, two-color for reliable mixing; Pourable Sealer by Firestone.
G. Seam Plates: Steel with barbs and Galvalume coating; corrosion-resistance complying with FM 4470.
H. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.10 inch thick; Firestone Termination Bar by Firestone.

I. Cut Edge Sealant: Synthetic rubber-based, for use where membrane reinforcement is exposed; UltraPly TPO Cut Edge Sealant by Firestone.

J. General Purpose Sealant: EPDM-based, one part, white general purpose sealant; UltraPly TPO General Purpose Sealant by Firestone.

K. Molded Flashing Accessories: Unreinforced TPO membrane pre-molded to suit a variety of flashing details, including pipe boots, inside corners, outside corners, etc.; UltraPly TPO Small and Large Pipe Flashing by Firestone.

L. Water Block Seal: Butyl rubber sealant for use between two surfaces, not exposed; Water Block Seal by Firestone.

M. Roof Walkway Pads: Non-reinforced TPO walkway pads, 0.130 inch by 30 inches by 40 feet long with patterned traffic bearing surface; UltraPly TPO Walkway Pads by Firestone.

## 2.4 ROOF INSULATION

A. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam with black glass reinforced mat laminated to faces, complying with ASTM C1289 Type II Class 1, with the following additional characteristics:
   1. Thickness: As indicated elsewhere.
   2. Size: 48 inches by 96 inches, nominal.
      a. Exception: Insulation to be attached using adhesive may be no larger than 48 inches by 48 inches, nominal.
   3. R-value (LTTR):
      a. inch Thickness: 6.0, minimum.
      b. inch Thickness: 7.5, minimum.
      c. inch Thickness: 9.0, minimum.
      d. inch Thickness: 10.5, minimum.
      e. inch Thickness: 12.1, minimum.
      f. inch Thickness: 18.5, minimum.
      g. inch Thickness: 25.0, minimum.
   4. Compressive Strength: 25 psi when tested in accordance with ASTM C1289.
   5. Ozone Depletion Potential: Zero; made without CFC or HCFC blowing agents.
   6. Recycled Content: 19 percent post-consumer and 15 percent post-industrial, average.

B. Adhesive for Insulation Attachment: Type as required by roof membrane manufacturer for roofing system and warranty to be provided; use only adhesives furnished by roof membrane manufacturer.

## 2.5 METAL ACCESSORIES

A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
   1. Wind Performance:
      a. Membrane Pull-Off Resistance: 100 lbs/ft, minimum, when tested in accordance with ANSI/SPRI/FM 4435/ES-1 Test Method RE-l, current edition.
      b. Fascia Pull-Off Resistance: At least the minimum required when tested in accordance with ANSI/SPRI/FM 4435/ES-1 Test Method RE-2, current edition.

2. Description: Metal accessories to be manufactured or formed shapes to meet project requirements as indicated on drawings.
3. Fascia Material and Finish: 0.040 inch thick formed aluminum, Kynar 500 finish to match color of metal wall panels in Section 07 42 13.19 Insulated Metal Wall Panels; matching concealed joint splice plates; factory-installed protective plastic film.
4. Length: Fascias, trims, etc to be manufactured in greatest length possible.
5. Functional Characteristics: Fascia retainer supports while allowing for free thermal cycling of fascia.
6. Aluminum Bar: Continuous 6063-T6 alloy aluminum extrusion with pre-punched slotted holes; miters welded; injection molded EPDM splices to allow thermal expansion.
7. Anchor Bar Cleat: 20 gage, 0.036 inch G90 coated commercial type galvanized steel with pre-punched holes.
8. Fasteners: Factory-provided corrosion resistant fasteners, with drivers; no exposed fasteners permitted.
9. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, scuppers, and end caps; minimum 14 inch long legs on corner pieces.
10. Accessories: Provide matching gutter, downspout, extenders, and other special fabrications as shown on the drawings in Kynar 500 finish to match color of metal wall panels in Section 07 42 13.19 - Insulated Metal Wall Panels.

### 2.6 ACCESSORY MATERIALS

A. Wood Nailers: PS 20 dimension lumber, Structural Grade No. 2 or better Southern Pine, Douglas Fir; or PS 1, APA Exterior Grade plywood; pressure preservative treated.
   1. Width: 3 1/2 inches, nominal minimum, or as wide as the nailing flange of the roof accessory to be attached to it or as indicated on drawings.
   2. Thickness: Same as thickness of roof insulation.
B. Splash Blocks: Precast concrete type, size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

## PART 3 INSTALLATION

### 3.1 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.
B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.
C. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.
D. Perform work using competent and properly equipped personnel.
E. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and

temporary closures shall be completed as required to provide a watertight condition.

F. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F.

G. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

H. Until ready for use, keep materials in their original containers as labeled by the manufacturer.

I. Consult membrane manufacturer's instructions, container labels, and Material Safety Data Sheets (MSDS) for specific safety instructions. Keep all adhesives, sealants, primers and cleaning materials away from all sources of ignition.

**3.2 EXAMINATION**

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Examine roof substrate to verify that it is properly sloped to drains.

D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

**3.3 PREPARATION**

A. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.

B. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.

C. Fill all surface voids in the immediate substrate that are greater than 1/4 inch wide with fill material acceptable insulation to membrane manufacturer.

D. Seal, grout, or tape deck joints, where needed, to prevent bitumen seepage into building.

**3.4 INSULATION INSTALLATION**

A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.

B. Install only as much insulation as can be covered with the completed roofing system before the end of the day's work or before the onset of inclement weather.

C. Lay roof insulation in courses parallel to roof edges.

D. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch.

**3.5 SINGLE-PLY MEMBRANE INSTALLATION**

A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.
B. Lay out the membrane pieces so that field and flashing splices are installed to shed water.
C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
D. Install membrane adhered to the substrate, with edge securement as specified.
E. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.
F. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.
    1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches square.
    2. Metal edging is not merely decorative; ensure anchorage of membrane as intended by roofing manufacturer.

**3.6 FLASHING AND ACCESSORIES INSTALLATION**

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.
B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on the drawings, with horizontal leg of edge member over membrane and flashing over metal onto membrane.
    1. Follow roofing manufacturer's instructions.
    2. Remove protective plastic surface film immediately before installation.
    3. Install water block sealant under the membrane anchorage leg.
    4. Flash with manufacturer's recommended flashing sheet unless otherwise indicated.
    5. Where single application of flashing will not completely cover the metal flange, install additional piece of flashing to cover the metal edge.
    6. If the roof edge includes a gravel stop and sealant is not applied between the laps in the metal edging, install an additional piece of self-adhesive flashing membrane over the metal lap to the top of the gravel stop; apply seam edge treatment at the intersections of the two flashing sections.
    7. When the roof slope is greater than l: 12, apply seam edge treatment along the back edge of the flashing.
C. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
    1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.

2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1 inch clearance from penetration, sloped to shed water.

**3.7 FINISHING AND WALKWAY INSTALLATION**

A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.

B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch and maximum of 3.0 inches from each other to allow for drainage.

1. If installation of walkway pads over field fabricated splices or within 6 inches of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches on either side.
2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.

**3.8 FIELD QUALITY CONTROL**

A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

B. Perform all corrections necessary for issuance of warranty.

**3.9 CLEANING**

A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.

B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.

C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

**3.10 PROTECTION**

A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

**END OF SECTION 07 54 23**

**SECTION 07 62 00**
**SHEET METAL FLASHING AND TRIM**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, gutters, and downspouts.
B. Sealants for joints within sheet metal fabrications.
C. Precast concrete splash pads.

### 1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
B. Section 07 54 23 - Thermoplastic-Polyolefin Roofing (TPO): Roofing system.
C. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

### 1.3 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
F. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
C. Samples: Submit two samples 4 by 4 inch in size illustrating metal finish color.

### 1.5 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

## PART 2 PRODUCTS

**2.1 MANUFACTURERS**

A. Sheet Metal Flashing and Trim Manufacturers:
   1. Metal -Era Engineered Roofing Solutions: www.metalera.com.
   2. OMG Roofing Products; _____: www.omgroofing.com/#sle.
   3. Or Equal: As approved by membrane roofing manufacturer to provide warranty specified.

**2.2 SHEET MATERIALS**

A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick; plain finish shop pre-coated with fluoropolymer coating.
   1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: As selected by Engineer from manufacturer's standard colors.

**2.3 ACCESSORIES**

A. Fasteners: Stainless steel, with soft neoprene washers.
B. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
C. Sealant to be Exposed in Completed Work: Elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; as selected by Engineer from sealant manufacturers full color line.
D. Sealant: Type as specified in Section 07 90 05.

**2.4 FABRICATION**

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
B. Form pieces in longest possible lengths.
C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

**2.5 GUTTER AND DOWNSPOUT FABRICATION**

A. Gutters: <> Square profile.
B. Downspouts: Rectangular profile.
C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
D. Accessories: Profiled to suit gutters and downspouts.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
   2. Gutter Supports: Brackets.
   3. Downspout Supports: Brackets.
E. Splash Pads: Precast concrete type, minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
F. Seal metal joints.

**2.6 ACCESSORIES**

A. Fasteners: Stainless steel, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; as selected by Engineer from manufacturer's full color line.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

**3.2 INSTALLATION**

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
B. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
C. Seal metal joints watertight.
D. Secure gutters and downspouts in place with concealed fasteners.
E. Slope gutters 1/4 inch per 10 feet, minimum.
F. Set splash pads under downspouts.

**END OF SECTION 07 62 00**

**SECTION 07 84 00**
**FIRESTOPPING**

## PART 1 GENERAL

### 1.1 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.
B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).
D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.
E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).
F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).
G. ITS (DIR) - Directory of Listed Products Current Edition.
H. FM (AG) - FM Approval Guide Current Edition.
I. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.
J. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.
K. UL (DIR) - Online Certifications Directory Current Edition.
L. UL (FRD) - Fire Resistance Directory Current Edition.

### 1.2 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Installer Qualification: Submit qualification statements for installing mechanics.

### 1.3 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
    1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section and:
    1. Trained by manufacturer.
    2. Verification of minimum three years documented experience installing work of this type.

### 1.4 MOCK-UP

A. Install one firestopping assembly representative of each fire rating design required on project.
   1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
   2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.
B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
C. If accepted, mock-up will represent minimum standard for the Work.
D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

### 1.5 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
B. Provide ventilation in areas where solvent-cured materials are being installed.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Manufacturers:
   1. A/D Fire Protection Systems Inc: www.adfire.com.
   2. 3M Fire Protection Products: www.3m.com/firestop.
   3. Hilti, Inc: www.us.hilti.com.
   4. Nelson FireStop Products: www.nelsonfirestop.com.
   5. Specified Technologies, Inc: www.stifirestop.com.
B. Firestopping Materials: Any materials meeting requirements.
C. Materials: Use any material meeting requirements.
D. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
E. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
F. Fire Ratings: Refer to drawings for required systems and ratings.

### 2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.
D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

**2.3 FIRESTOPPING SYSTEMS**

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify openings are ready to receive the work of this section.

**3.2 PREPARATION**

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.

**3.3 INSTALLATION**

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

**3.4 CLEANING**

A. Clean adjacent surfaces of firestopping materials.

**3.5 PROTECTION**

A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION 07 84 00**

**SECTION 07 90 05**
**JOINT SEALERS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Sealants and joint backing.
B. Precompressed foam sealers.

### 1.2 RELATED REQUIREMENTS

A. Section 08 80 00 - Glazing: Glazing sealants and accessories.

### 1.3 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants 2017.
B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
C. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
D. ASTM C1311 - Standard Specification for Solvent Release Sealants 2022.
E. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber 2020.
F. ASTM D1667 - Standard Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell) 2022.
G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

### 1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating sealant chemical characteristics.
C. Samples: Submit two samples, 3x3 inch in size illustrating sealant colors for selection.
D. Manufacturer's Installation Instructions: Indicate special procedures.

### 1.6 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.
B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

### 1.7 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

### 1.8 WARRANTY

A. See Section 01 70 00 - Project Closeout, for additional warranty requirements.
B. Correct defective work within a five year period after Date of Substantial Completion.
C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Gunnable and Pourable Sealants:
   1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com/#sle.
   2. Bostik Inc: www.bostik-us.com/#sle.
   3. Dow Corning Corporation: www.dowcorning.com/#sle.
   4. Pecora Corporation: www.pecora.com/#sle.
   5. Tremco Global Sealants: www.tremcosealants.com/#sle.
   6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

B. Preformed Compressible Foam Sealers:
   1. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
   2. Sandell Manufacturing Company, Inc: www.sandellmfg.com/#sle.
   3. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
   4. Tremco Global Sealants: www.tremcosealants.com/#sle.

### 2.2 SEALANTS

A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
   1. Color: To be selected by Engineer from manufacturer's standard range.
   2. Applications: Use for:
      a. Control, expansion, and soft joints in masonry.
      b. Joints between concrete and other materials.
      c. Joints between metal frames and other materials.
      d. Other exterior joints for which no other sealant is indicated.
   3. Polyurethane Products:
      a. Bostik Inc: www.bostik-us.com/#sle.
      b. Pecora Corporation: www.pecora.com/#sle.
      c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com/#sle.
      d. Sika Corporation: www.usa-sika.com/#sle.

B. Exterior Expansion Joint Sealer: Precompressed foam sealer; urethane with water-repellent;
   1. Color: Black.
   2. Size as required to provide weathertight seal when installed.
   3. Applications: Use for:
      a. Exterior wall expansion joints.
   4. Products:
      a. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
      b. Sandell Manufacturing Company, Inc: www.sandellmfg.com/#sle.
      c. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
      d. Tremco Global Sealants: www.tremcosealants.com/#sle.

C. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring, as approved by metal roofing and siding panel manufacturers.
   1. Applications: Use for:

a. Concealed sealant bead in sheet metal work.
b. Concealed sealant bead in siding overlaps.

D. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
1. Color: To be selected by Engineer from manufacturer's standard range.
2. Applications: Use for:
a. Interior wall and ceiling control joints.
b. Joints between door and window frames and wall surfaces.
c. Other interior joints for which no other type of sealant is indicated.
3. Products:
a. Bostik Inc: www.bostik-us.com/#sle.
b. Pecora Corporation: www.pecora.com/#sle.
c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com/#sle.
d. Tremco Global Sealants: www.tremcosealants.com/#sle.

E. Concrete Paving Joint Sealant: Polyurethane, self-leveling; ASTM C920, Class 25, Uses T, I, M and A; single component.
1. Color: Gray.
2. Applications: Use for:
a. Joints in sidewalks and vehicular paving.
3. Products:
a. Bostik Inc: www.bostik-us.com/#sle.
b. Pecora Corporation: www.pecora.com/#sle.
c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com/#sle.

F. Silicone Sealant: ASTM C920, Grade NS, Class 25 minimum; Uses NT, A, G, M, O; single component, solvent curing, non-sagging, non-staining, fungus resistant, non-bleeding.
1. Color: To be selected by Engineer from manufacturer's standard range.
2. Movement Capability: Plus and minus 25 percent.
3. Service Temperature Range: -65 to 180 degrees F.
4. Shore A Hardness Range: 15 to 35.
5. Products:
a. Bostik Inc: www.bostik-us.com/#sle.
b. Pecora Corporation: www.pecora.com/#sle.
c. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com/#sle.
d. Tremco Global Sealants: www.tremcosealants.com/#sle.
e. Sika Corporation: www.usa-sika.com/#sle.

## 2.3 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056 sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.
D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Verify that joint backing and release tapes are compatible with sealant.

### 3.2 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.
B. Clean and prime joints in accordance with manufacturer's instructions.
C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
D. Protect elements surrounding the work of this section from damage or disfigurement.

### 3.3 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
D. Install bond breaker where joint backing is not used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
G. Tool joints concave.
H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

### 3.4 CLEANING

A. Clean adjacent soiled surfaces.

### 3.5 PROTECTION

A. Protect sealants until cured.

**END OF SECTION 07 90 05**

**SECTION 08 16 13**
**FIBERGLASS DOORS AND FRAMES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Fiberglass reinforced plastic (FRP) doors.
B. Frames for fiberglass reinforced plastic doors.
C. Glazing.
D. Accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Door hardware.
B. Section 08 80 00 - Glazing.

### 1.3 REFERENCE STANDARDS

A. ANSI A250.4 - American National Standard Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcings; 2011.
B. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2010.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

### 1.4 SUBMITTALS

A. Product Data: Provide manufacturer's standard details, installation instructions, and hardware and anchor recommendations.
B. Shop Drawings: Show layout and profiles; include assembly methods.
    1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
    2. Indicate wall conditions, door and frame elevations, sections, materials, gages, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on Drawings to identify details and openings.
C. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.
D. Door Corner Sample: Submit corner cross sections, 10 inch by 10 inch in size, illustrating construction, finish, color, and texture.
E. Maintenance Data: Include instructions for repair of minor scratches and damage.
F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Mark doors with location of installation, door type, color, and weight.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
   1. Store at temperature and humidity conditions recommended by manufacturer.
   2. Do not use non-vented plastic or canvas shelters.
   3. Immediately remove wet wrappers.
D. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inches space between doors.

**1.7 FIELD CONDITIONS**

A. Do not install doors until structure is enclosed.
B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.

**1.8 WARRANTY**

A. Provide five (5) year manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

A. Molded Fiberglass Doors:
   1. ChemPruf Door Company, Ltd: www.chem-pruf.com.
   2. Tiger Door LLC: www.tigerdoor.com.
   3. Warminster Fiberglass: www.warminsterfiberglass.com.

**2.2 DOOR AND FRAME ASSEMBLIES**

A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
   1. Mechanical Durability: Tested to ANSI A250.4 Level A (1,000,000 cycles), minimum; tested with hardware and fasteners intended for use on project.
   2. Screw-Holding Capacity: Tested to 900 psi, minimum.
   3. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A; when tested in accordance with ASTM E84.
   4. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
   5. Chemical Resistance: Resist degradation due to exposure to tap water, distilled water, and:
      a. Chlorine-treated moisture in air.
   6. Provide products that meet USDA requirements for incidental food contact.
   7. Clearance Between Door and Frame: 1/8 inch, maximum.
   8. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
   9. Provide frame anchors that allow for variation in rough opening size; do not field cut doors or frames to fit.

**2.3 COMPONENTS**

A. Doors: Through-color gel coating on fiberglass reinforced polyester resin construction with reinforced core.
   1. Thickness: 1-3/4 inches, overall.
   2. Door Construction: Molded in one piece including gel coating on all sides; manufacturer's standard subframe, core and faces fused during cure in mold; hardware reinforcements
   3. Subframe and Reinforcements: Fiberglass pultrusions or polymer foam; no metal or wood.
   4. Waterproof Integrity: All edges, cut-outs, and hardware preparations factory fabricated of fiberglass reinforced plastic; provide cut-outs with joints sealed independently of glazing or louver inserts or trim.
   5. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary; obtain manufacturer's templates for hardware preparations.
   6. Gel Coating: Ultraviolet stabilized polyester, marine grade NPG-isophthalic, with slightly textured semi-gloss final finish.
   7. Gel Coating Thickness: Minimum 25 mils wet, plus/minus 3 mils.
   8. Gel Coating Color: As selected by the Professional from the manufacturer's standard line of colors.

B. Frames: Profiles and dimensions as indicated on drawings; same type and construction used in mechanical durability test for doors.
   1. Construction for Non-Fire-Rated Doors: Use one of the following:
      a. Molded fiberglass with gel-coating matching doors.
   2. Construction for Fire-Rated Doors: Provide frames bearing labels to match doors; use one of the following:
      a. Molded fiberglass with gel-coating matching doors.
   3. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant.
   4. At hardware cut-outs provide continuous backing or mortar guards of same material as frame, sealed watertight.
   5. Frame Anchors: Stainless steel, Type 304; provide 3 anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.

C. Hinge and Hardware Fasteners: Stainless steel, Type 304; wood screws.

## 2.4 ACCESSORIES

A. Glazing Stops: Pultruded fiberglass unless otherwise indicated or required by fire rating; provided by door manufacturer to fit factory made openings, color and texture to match door; fasteners not penetrating waterproof integrity.
   1. Glazed Openings: Provide removable stops on one side.
   2. Opening Sizes: As indicated on drawings.

B. Type GL-1: Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch, nominal.

5. Glazing Method: Dry glazing method, gasket glazing.

C. Type GL-5: Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period.
   1. Applications:
      a. Glazing in fire-rated door assembly.
      b. Other locations as indicated on drawings.
   2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
   3. Safety Glazing Certification: 16 CFR 1201 Category II.
   4. Fire-Rating Period: As indicated on drawings.
   5. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on
      a. fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.

D. Fiberglass Reinforced Plastic Sweeps: Provide fiberglass reinforced door sweep by door manufacturer, color to match door.

E. Fiberglass Reinforced Plastic Threshold: Provide fiberglass reinforced plastic threshold, profile to meet application, to be field verified by door manufacturer, color to match door.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.

B. Do not begin installation until substrates have been properly prepared.

**3.2 PREPARATION**

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

B. Clean and prepare substrate in accordance with manufacturer's directions.

**3.3 INSTALLATION**

A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.

B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.

C. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

D. Repair to acceptance of Professional or replace as directed by Professional damaged installed products.

**3.4 ADJUSTING**

A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.

B. Adjust hardware for smooth and quiet operation.

C. Adjust doors to fit snugly and close without sticking or binding.

**3.5 CLEANING**

A. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance.

**3.6 PROTECTION**

A. Protect installed products from damage during subsequent work.

**END OF SECTION 08 16 13**

**SECTION 08 36 13**
**SECTIONAL DOORS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Overhead sectional doors, manually operated.
B. Operating hardware and supports.

### 1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Prepared opening in masonry.
B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

### 1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
C. DASMA 102 - American National Standard Specifications for Sectional Doors 2018.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
C. Product Data: Show component construction, anchorage method, and hardware.
D. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
E. Operation Data: Include normal operation, troubleshooting, and adjusting.
F. Maintenance Data: Include data forshaft and gearing, lubrication frequency, spare part sources.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.

### 1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for warranty requirements.
B. Correct defective Work within a one year period after Date of Substantial Completion.
C. Provide five year manufacturer warranty for electric operating equipment.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design: Thermacore 596 Series Insulated Steel Door manufactured by Overhead Door Corporation.
B. Other Acceptable Manufacturers - Sectional Doors:
   1. C.H.I. Overhead Doors: www.chiohd.com/#sle.
   2. Clopay Building Products: www.clopaydoor.com/#sle.
   3. Garaga Inc: www.garaga.com.

**2.2 STEEL DOORS**

A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
   1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
   2. Door Nominal Thickness: 2 inches thick.
   3. Thermal Transmittance: U-factor of 0.057 Btu/hr sq ft degrees F, maximum, in accordance with DASMA 102.
   4. Thermal Resistance: R-value of 17.40, minimum, for overall thickness indicated.
   5. Air Infiltration: 0.08cfm @ 15 mph; 0.08 cfm @ 25 mph.
   6. Exterior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.
   7. Interior Finish: Factory finished with polyester baked enamel; color as selected from manufacturers standard line.
B. Door Panels: Steel construction; outer steel sheet of 20 gage, 0.0359 inch minimum thickness, flush profile; inner steel sheet of 20 gage, 0.0359 inch minimum thickness, flat profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

**2.3 COMPONENTS**

A. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
B. Shaft: Heavy duty solid steel shafts.
C. Support struts: Provide support struts on each door section.
D. Torsion Springs: Provide heavy duty torsions springs rated for 75,000 cycles minimum.
E. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
F. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
G. Head Weatherstripping: EPDM rubber seal, one piece full length.
H. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
I. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior handle.

**2.4 MATERIALS**

A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating, plain surface.
B. Insulation: Foamed-in-place polyurethane, bonded to facing.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.

### 3.2 PREPARATION

A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.

### 3.3 INSTALLATION

A. Install door unit assembly in accordance with manufacturer's instructions.
B. Anchor assembly to wall construction and building framing without distortion or stress.
C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
D. Fit and align door assembly including hardware.

### 3.4 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch.
B. Maximum Variation from Level: 1/16 inch.
C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch from 10 ft straight edge.
D. Maintain dimensional tolerances and alignment with adjacent work.

### 3.5 ADJUSTING

A. Adjust door assembly for smooth operation and full contact with weatherstripping.
B. Have manufacturer's field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

### 3.6 CLEANING

A. Clean doors and frames.
B. Remove temporary labels and visible markings.

### 3.7 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.
B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

**END OF SECTION 08 36 13**

**SECTION 08 71 00**
**DOOR HARDWARE**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Hardware for swinging FRP Openings.
B. Related Sections:
   1. Section 01 25 13 – Product Substitution Procedures
   2. Section 06 20 00 – Finish Carpentry

### 1.2 REFERENCES

A. Use the following references to properly detail, schedule, furnish and install finish hardware items.
   1. NFPA 80 – Standard for Fire Doors and Other Opening Protectives (2007)
   2. DHI Installation Guide for Doors and Hardware (1984)
   3. DHI Sequence and Format for the Hardware Schedule (1996)
   4. ANSI/BHMA A156.4 – Door Controls – Closers (2013)
   5. ANSI/BHMA A156.18 – Materials and Finishes (2012)

### 1.3 SUBMITTALS

A. Schedule:
   1. Provide submittals in accordance with 01 33 00 – Submittal Procedures.
   2. Provide hardware schedule in vertical format on 8-1/2-inch by 11-inch paper or electronic format. Conform to DHI publication Sequence and Format for Hardware Schedule using Architect's door numbers and hardware set numbers.
   3. Provide elevation drawings for openings with electrical hardware and access control devices with each hardware schedule. Include illustration of opening, operational description, electrified hardware components, legend, approximate mounting location and size of enclosures, size and quantity of conductors, facility name and date.
B. Product Data: Provide one set of manufacturer's catalog and technical data for each hardware item used, highlighting design, function, fasteners, accessories, and options to facilitate review with each hardware schedule submitted.
C. Templates: Provide two sets of manufacturer's templating information for mortised and template hardware upon receipt of approved hardware schedule to the door and frame supplier(s). Include requirements for internal reinforcements required for surface mounted hardware.
D. Wiring Diagrams:
   1. Three sets point-to-point diagrams specially developed for each opening that requires electrical hardware, with hardware delivery to jobsite. Reference elevation drawings submitted with hardware schedule using Architect's opening numbers.
E. Keying Schedule: Arrange meeting with Owner, Architect and finish hardware supplier to determine keying requirements immediately upon receipt of finish hardware schedule.

### 1.4 CLOSEOUT SUBMITTALS

A. Furnish operations and maintenance manual is accordance with Section 01 78 28 – Operations and Maintenance Data and as follows:
   1. Furnish one copy of manual at date of Substantial Completion in a 2-1/2-inch thick binder labeled with project information, date and name and contact information for the hardware supplier.
   2. Include in manual:
      a. Copy of approved hardware schedule, including door numbers and locations. Highlight fire rated door to aid in annual fire door inspection.
      b. Copy of approved keying schedule.
      c. Catalog data for each product.
      d. As-installed "wiring diagrams" for each opening connected to power.
      e. Parts list for locksets, exit devices, and door closers.
      f. Installation templates and instructions.
      g. Warranty information.
      h. Name, address, and phone number of local representatives for each manufacturer.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

A. Extra Materials:
   1. Screws and Fasteners: Fifty of each screw and fastener required for general maintenance of hinges, locks, closers, exit devices, and sealing systems.
   2. Deliver to Owner remaining finish hardware fasteners and special installation tools upon completion of Project.

**1.6 QUALITY ASSURANCE**

A. Supplier:
   1. Furnish hardware from recognized supplier who has warehousing facility within 100 miles of project location, and who has actively supplied hardware for similar projects in the vicinity for a minimum of five years.
   2. Supplier shall employ an Architectural Hardware Consultant (AHC), as certified by Door and Hardware Institute, on staff full time to administer and supervise project.

B. Installer: Install hardware using installers who have actively installed commercial door hardware for a minimum of five years, and are familiar with hardware installation of type required on this Project.

C. Pre-Installation Meeting:
   1. Prior to installation of hardware, arrange for manufacturer's representatives of locksets, door closers, and exit devices to hold a jobsite meeting to instruct the installing personnel on the proper installation of their products.
   2. Send a letter of compliance, indicating when this meeting was held, and who was in attendance, to the Architect and Owner.

D. Fire Rated Door Openings:
   1. Comply with NFPA 80.
   2. Furnish nationally recognized testing agency label or stamp on hardware for labeled openings.
   3. Only labeled locks or latches or fire exit hardware can be used on fire rated openings.
   4. Where UL requirements conflict with Drawings or Specifications, furnish hardware conforming to the UL requirements.

**1.7 DELIVERY, STORAGE, AND HANDLING**

A. Delivery:
   1. Jointly check in hardware, upon delivery to jobsite, against approved hardware schedule with hardware supplier. Record shortage or damage and replace or repair as necessary.
   2. Deliver hardware to be installed during fabrication of doors and frames, to manufacturer.

B. Storage:
   1. Store hardware in a secure, dry, temperature controlled room on shelving to protect against loss, theft and damage.
   2. Store items too long for shelving on pallet, off the floor.

C. Marking and Packaging:
   1. Deliver hardware to jobsite in manufacturer's original packaging marked to correspond with approved hardware schedule with Architect's door numbers and hardware sets.
   2. Mark all locksets, exit devices, cylinders, auxiliary hardware and key switches with keyset symbol.
   3. Replace any wet or damaged packaging with new.

**1.8 WARRANTY**

A. Furnish warranties in accordance with Section 01 78 36 – Warranties. Extended or limited warranties shall be as follows:
   1. Furnish minimum ten year factory warranty on door closers, against defects in material and workmanship, from date of substantial completion.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

A. The following manufacturers' were used in the hardware sets.
   1. ABH AB
   2. Best BE
   3. Precision PR
   4. Trimco TR
   5. Trimco TR
   6. National Guard NA
   7. Trimco TR

B. Submit requests for substitution in accordance with Section 01 25 13 Product Substitution requirements and as follows:
   1. Provide catalog data with product information highlighted or bubbled to facilitate review. Product must meet or exceed level or design intended and/or function established by specified products.

**2.2 MATERIALS**

A. Screws and Fasteners:
   1. Provide manufacturer's recommended fasteners of proper type, material and finish.
   2. Provide self-tapping screws for sweeps and stop applied weatherstripping.
   3. Utilize through-bolts for the attachment of door closers and exit devices on non-reinforced doors only. Finish: match door face.

4. Exposed screw heads: phillips type.

B. Continuous Hinges:
   1. Configuration appropriate for type, inset, and thickness of door. Coordinate with door manufacturer.
   2. Meet UL fire label listing requirements at UL rated openings. Include fire pins as required by manufacturer.
   3. Acceptable manufacturers and types:
      a. Manufacturer: ABH Stanley Hager
      b. Model No.: A500 651 790-900
      c. Door Type: FRP.

C. Locksets:
   1. Cylinders:
      a. Provide mortise and rim cylinders and cores from same manufacturer as locksets, for all locksets, exit devices, cylinder dogging, key switches and auxiliary hardware.
      b. Appropriate cam and blocking rings for proper installation

D. Keys & Keying
   1. Cylinders: Provide rim and mortise cylinders as required to MATCH EXISTING KEY SYSTEM.
   2. Verify with Owner type of existing key system.
   3. Key each cylinder to Owner's requirements including Master keying / Grand masterkeying as required.
   4. Provide construction keying and keys during construction period.
   5. Permanent Keys: All permanent keys are to be delivered to Owner per Owner's stated delivery method.
   6. Furnish keys in the following quantities:
      a. 4 each Masterkeys and Gran Masterkeys per new Masterkey set.
      b. 2 each Change keys each keyed core.
      c. 6 each Construction Masterkeys..
         1) Install permanent cores in locksets.
         2) Return construction cores to Hardware Supplier.

E. Exit Devices:
   1. UL-listed for fire at fire door assemblies, and UL listed for panic at non-rated door assemblies.
   2. Size exit devices to proper door width and height.
   3. Stainless Steel deadlocking ¾ -inch throw latch bolt.
   4. LBR (less bottom rod) where scheduled to eliminate use of floor mounted strikes.
   5. Cylinders for exit devices with cylinder dogging or locking trim.
   6. Electrical functions as scheduled in sets. Provide power supply and power transfer from same manufacturer as electrified exit device.
   7. Strike: as recommended by manufacturer.
   8. Lever design: To match lockset trim.
   9. Acceptable manufacturers and types:
      a. Manufacturer: Precision Equals
      b. Model No.: Apex 2000 Series As approved by Architect/Engineer

F. Surface Door Closers:

1. Conform to ANSI/BHMA A156.4 Grade 1.
2. Heavy duty high silicon aluminum alloy or cast iron body closers.
3. Furnish manufacturers recommended size, arms and configuration for door and frame application required.
4. Furnish brackets, spacers, support shoes, and plates for complete and proper installation.
5. Acceptable manufacturers and types:
   a. Manufacturer: Best Access Equals
   b. Model No.: HD8000Series As approved by Architect/Engineer

G. Door Stops:
1. Convex, cast, wall stops.
2. Furnish fastener suitable for wall condition.
3. Provide wedge type stop for doors with push/pulls.
4. Where wall stops are inappropriate provide universal dome type floor stops.
5. Acceptable manufacturers and types:
   a. Wall Stop.
      1) Manufacturer: Trimco Burns Rockwood
      2) Model No.: 1270CX 560 400
   b. Wall Stop.
      1) Manufacturer: Trimco Burns Rockwood
      2) Model No.: 1298 526 487

H. Gasketing:
1. Gasketing:
   1) Meeting-stile gasketing required at exterior pairs of doors.
2. Acceptable manufacturers and types:
   1) Type: Rigid.
      (a) Manufacturer: National Guard Pemko
      (b) Model No.: 2525B PK33
   2) Type: Mullion Seal.
      (a) Manufacturer: National Guard Pemko
      (b) Model No.: 5100N 5110

I. Silencers:
1. Grey rubber silencers with injector tool.
2. Three silencers at single doors and two silencers at pairs.
3. Acceptable manufacturers and types:
   a. Manufacturer: Trimco Burns Rockwood
   b. Model No.: 1229A 608 500

## 2.3 KEY CONTROL

A. Key cabinet: wall mounted with one hook for each lock or cylinder plus fifty extra hooks.
   a. One non-removable security tag and one snap-on link duplicate tag per hook.
   b. Furnish tools, instructions sheets and accessories required to complete installation.
   c. Manufacturers: Telkee.

## 2.4 FINISHES

A. Conform to ANSI/BHMA A156.18.
   1. 630 Stainless Steel
   2. 626 Satin Chrome
   3. 626W Satin Chrome Plated Brass
   4. 689 Spray Painted Aluminum
   5. 626 Satin Chrome Plated Brass
   6. AL Anodized Mil Finished Aluminum

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify doors and frames are plumb, square, level and true and free from defects that would prevent proper installation of finish hardware.
B. Verify power is run to doors requiring electrified hardware.
C. Wash down masonry walls and complete painting and staining of doors and frames prior to installation of hardware.
D. Complete finish flooring at doorways.
E. Correct conditions that inhibit a proper installation before continuing with work.

**3.2 INSTALLATION**

A. Install hardware in compliance with the DHI publication, Installation Guide for Doors and Hardware.
B. Drill and countersink items not factory prepared for fasteners.
C. Mount closers on room-side of corridor doors, inside of exterior doors, and stair-side of stairway doors. Use necessary arms, brackets, spacers and plates to accommodate auxiliary hardware and special applications.
D. Install fire door assemblies to maintain clearances at door edge to frame and meeting edge of pairs of doors in compliance with NFPA 80, providing 1/8-inch clearance at the hinge edge, lock edge, head and between pairs. Provide maximum 3/4-inch undercut at door bottom. Where panic thresholds are used, undercut door to allow 1/8-inch clearance between door and threshold.
E. Trim, cut, and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Set thresholds in bed of mastic sealant, forming tight seal between threshold and surface to which set.
F. Use only fasteners furnished by manufacturer for installation as recommended by manufacturer.
G. Install blocking material for all wall mounted door stops at height appropriate to contact door trim.
H. Install weather-strip prior to installation of door closers and exit devices. Do not cut or notch weather-strip.
I. Locate electric hinges at second hinge from bottom of frame.
J. Termination of wiring: Ensure wiring is in place and is connected for proper operation of hardware.

**3.3 FIELD QUALITY CONTROL**

A. Verify doors open and close smoothly without rubbing or catching and have positive latching where scheduled. Verify fire rated doors are installed with clearances in compliance with NFPA 80.
B. Test electrified hold open devices tied into fire alarm system to confirm release upon activation of fire alarm. Test electrified hardware and access control to verify systems operate as directed in mode of operation. Where hardware is found to be inoperable, repair or replace with new.

**3.4 ADJUSTING AND CLEANING**

A. Upon substantial completion, make final adjustments to door closers and other items of hardware after balance of heating and ventilating equipment to ensure doors close and latch properly.
B. Clean and polish all exposed hardware surfaces in accordance with manufacturer's recommended procedures.
C. Clean or repair pencil or tool marks from adjacent surfaces damaged or soiled by work of this Section.
D. Recycle cardboard boxes and paper products used in packaging and transport of finish hardware.

**3.5 PROTECTION**

A. Remove hardware prior to painting or finishing door and frame. Wrap or mask exposed hardware that cannot be removed until date of substantial completion to avoid exposure to paint, solvents, and abuse.
B. Repair or replace hardware damaged during construction at least two weeks prior to date of substantial completion.

**3.6 SCHEDULES**

A. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
B. Where items of hardware aren't definitely or correctly specified, are required for
   1. completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

**3.7 MANUFACTURER LIST**

| A. CODE | NAME |
|---|---|
| AB | ABH Manufacturing Inc. |
| BE | Best Access Systems |
| BY | By Others |
| NA | National Guard |
| PR | Precision |

**3.8 OPTION LIST**

| A. CODE | DESCRIPTION |
|---|---|
| CD | Cylinder Dogging |
| MCS | Mullion Cap Spacer |
| SN134 | 1-3/4" Door SN134 Screw Pack |
| SNB (2) | Sex Bolts (2) |
| SNB (6) | Sex Bolts (6) |

**3.9 FINISH LIST**

| A. CODE | DESCRIPTION |
|---|---|
| 600 | Primed for Painting |
| 626 | Satin Chromium Plated |
| 689 | Aluminum Painted |

| | |
|---|---|
| 626W | Weatherized Satin Chrome |
| US32D | Stainless Steel, Dull |

**3.10 HARDWARE SETS**

A. SET #01 - Exterior Pair

Doors: 101A, 102A

| | | | | |
|---|---|---|---|---|
| 2 | Continuous Hinge | A500 x Fasteners as Req'd for application | US32D | AB |
| 1 | Removable Mullion | KR822 MCS | 600 | PR |
| 1 | Exit Device | 2101 SNB (6) | 626W | PR |
| 1 | Exit Device | 2103 X 4903A CD SNB (2) | 626W | PR |
| 1 | Mortise Cylinder | As Req'd To Match Existing Key System | 626 | |
| 2 | Rim Cylinder | As Req'd To Match Existing Key System | 626 | |
| 2 | Closer | HD8016 SDST SN134 | 689 | BE |
| 1 | Drip Cap | 16 A - 4" ODW | | NA |
| 1 | Gasketing | 2525 B @ Head & Jambs | | NA |
| 1 | Mullion Seal | 5100N | | NA |
| 1 | Threshold | By FRP Door / Frame MFR. BY | | |
| 1 | Door Sweep | By FRP Door / Frame MFR. BY | | |

B. SET #02 - Overhead Door

Doors: 102B

NOTE: All hardware by sliding door manufacturer.

**END OF SECTION 08 71 00**

**SECTION 08 91 00**
**LlouvERS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Louvers, frames, and accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealing frames to weather barrier installed on adjacent construction.
B. Section 07 90 05 - Joint Sealers.

### 1.3 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2020.
B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012, with Editorial Revision (2015).
C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021, with Editorial Revision (2022).
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2023.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
D. Test Reports: Independent agency reports showing compliance with specified performance criteria.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

### 1.6 WARRANTY

A. See Section 01 70 00 - Project Closeout, for additional warranty requirements.
B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
    1. Finish: Include twenty year coverage against degradation of exterior finish.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

### 2.2 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
   2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
   3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame.
   1. Free Area: 50 percent, minimum.
   2. Blades: Straight.
   3. Frame: 4 inches deep, channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
   4. Aluminum Thickness: Frame 12 gage, 0.0808 inch minimum; blades 12 gage, 0.0808 inch minimum.
   5. Aluminum Finish: Class I natural anodized; to match existing.

C. Operable Louvers: Operable horizontal blades, extruded aluminum construction.
   1. Free Area: 50 percent, minimum.
   2. Operation: Actuator provided in HVAC control system.
   3. Frame: 4 inches deep, channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
   4. Aluminum Thickness: Frame 12 gage, 0.0808 inch minimum; blades 12 gage, 0.0808 inch minimum.
   5. Aluminum Finish: Class I color anodized; to match existing.

## 2.3 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).
   1. Clear Anodizing: AAMA 611 Class I, AA-M12C22A41.

B. Stainless Steel: ASTM A666, Type 304, soft temper, smooth surface, No. 4 brushed finish.

C. Bird Screen: Interwoven wire mesh of steel, 0.063 inch diameter wire, 1/2 inch open weave, diagonal design.

D. Insect Screen: 18 x 16 size aluminum mesh.

## 2.4 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

## 2.5 ACCESSORIES

A. Blank-Off Panels: Stainless steel face and back sheets, polyisocyanurate foam core, 2 inch thick; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct and where indicated on drawings. Provide matching trim for complete installation.

B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
C. Fasteners and Anchors: Stainless steel.
D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
B. Verify that field measurements are as indicated.

### 3.2 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.
B. Install louvers level and plumb.
C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
D. Secure louver frames in openings with concealed fasteners.
E. Coordinate with installation of mechanical ductwork.
F. Coordinate with installation of louver actuators.

### 3.3 ADJUSTING

A. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

### 3.4 CLEANING

A. Strip protective finish coverings.
B. Clean surfaces and components.

**END OF SECTION 08 91 00**

**SECTION 09 22 16**
**NON-STRUCTURAL METAL FRAMING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Metal partition and soffit and wall framing.
B. Framing accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry.
B. Section 06 17 53 - Shop-Fabricated Wood Trusses.
C. Section 07 25 00 - Weather Barriers.
D. Section 07 42 13.19 - Insulated Metal Wall Panels.

### 1.3 REFERENCE STANDARDS

A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Shop Drawings:
   1. Indicate component details, anchorage to structure, type and location of fasteners, accessories, and items of other related work.
C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a member of one of the following:
   1. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
   2. Manufacturer Qualifications: Member of Supreme Steel Framing System Association (SSFSA): www.ssfsa.com/#sle.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Metal Framing, Connectors, and Accessories:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Jaimes Industries: www.jaimesind.com/#sle.
   4. Marino: www.marinoware.com/#sle.
   5. SCAFCO Corporation: www.scafco.com/#sle.

**2.2 FRAMING MATERIALS**

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Furring: Hat-shaped sections, minimum depth of 7/8 inch, 20 gauge, galvanized steel.

**2.3 FABRICATION**

A. Fabricate assemblies of framed sections to sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify existing conditions before starting work.
B. Verify that rough-in utilities are in proper location.

**3.2 INSTALLATION OF STUD FRAMING**

A. Fit furring under, above and around all openings; as required for installation of finished wall and soffit systems.
B. Coordinate installation furring with electrical, mechanical, and other work to be placed within or behind finished wall and soffit systems
C. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

**END OF SECTION 09 22 16**

**SECTION 09 67 00**
**FLUID-APPLIED FLOORING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Fluid-applied flooring and base (integral cove base).

### 1.2 RELATED REQUIREMENTS

A. Section 07 90 05 - Joint Sealers: Joint between base and wall surface.

### 1.3 REFERENCE STANDARDS

A. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
B. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2014.
C. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2010.
D. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser; 2014.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physicaland performance characteristics; sizes, patterns and colors available.
C. Samples: Submit two samples, 4 by 4 inch in size illustrating color and pattern for each floor material for each color specified.
D. Manufacturer's Installation Instructions: Indicate special procedures.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 70 00 - Project Closeout, for additional provisions.
    2. Extra Flooring Material: 2 gallons of each color installed.

### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five yearsdocumented experience.
B. Applicator Qualifications: Company specializing in performing work of this section with minimum five years experience.
C. Mock-ups: Apply mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
    1. Apply full thickness mock ups on 48 inch square floor area selected by Engineer and Owner. Include 48 inch length of integral cove base with inside and outside corner.
    2. Simulate finished lighting conditions for Engineer's review of mock-ups.
D. Preinstallation Conference: Conduct conference at Project site.

### 1.6 MOCK UP

A. Construct mock-up(s) of fluid applied flooring to serve as basis for evaluation of texture and workmanship.
   1. Number of Mock-Ups to be Prepared: One.
   2. Use same materials and methods for use in the work.
   3. Use approved design samples as basis for mock-ups.
   4. Locate where directed.
   5. Minimum Size: 48 by 48 inches.

B. See Section 01 40 00 - Quality Requirements for additional requirements.

C. Obtain approval of mock-up by Engineer before proceeding with work.
   1. DELIVERY, STORAGE, AND HANDLING

D. Store resin materials in a dry, secure area.

### 1.7 FIELD CONDITIONS

A. Maintain minimum temperature in storage area of 55 degrees F.

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide Dur-A-Flex, Inc.;
   1. Hybri-Flex AQ (self leveling broadcast colored quartz), epoxy resin broadcast and polyaspartic ester topcoat seamless flooring system or comparable product by one of the following:
   2. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
   3. Crossfield Products Corp: www.crossfieldproducts.com.
   4. Sherwin-Williams Company: General Polymers Brand: www.generalpolymers.com.
   5. Or equal.

B. System:
   1. Topping: Poly-Crete MD resin, hardener and SL aggregate.
   2. Quartz Aggregate: Q 28 colored quartz.
   3. Broadcast coat: #4 resin and hardener.
   4. Topcoats: #5 resin and hardener.

### 2.2 RESINOUS FLOORING

A. Abrasion, impact and chemical resistant, decorative aggregate filled, epoxy resin based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.

B. System Characteristics:
   1. Color: As selected by Engineer from manufacturer's full standard color selections.
   2. Wearing Surface: Orange peel texture.
   3. Overall System Thickness: 1/4 inch.
   4. Integral Cove Base: 4 inches high.

C. Body Coats: Epoxy resin.

1. Formulation Description: 100 percent solids.
2. Application Method: Troweled or screeded.
    a. Thickness of Coats: 1/8 inch.
    b. Number of Coats: One.
3. Aggregates: Manufacturer's standard.

D. Topcoat: Sealing or finish coats.
1. Resin: Urethane.
2. Formulation Description: 100 percent solids.
3. Type: Clear.
4. Finish: Matte.
5. Number of Coats: One.

**2.3 ACCESSORIES**

A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
B. Reinforcing Membrane:
1. Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
2. Provide fiberglass scrim embedded in reinforcing membrane.
C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

**2.4 ACCESSORIES**

A. Subfloor Filler: Type recommended by flooring material manufacturer.

**PART 3 EXECUTION**

**3.1 PREPARATION**

A. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
    a. Shot blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture vapor emissions are within acceptable levels according to manufacturer's written instructions.
    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
    b. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.

c. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

B. Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

C. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

D. Treat control joints and other non-moving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

**3.2 APPLICATION**

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply reinforcing membrane to substrate cracks and joints.

D. Integral 4 inch high Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, toweling, sanding, and topcoating of cove base. Round internal and external corners.

E. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.

F. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

G. Protect resinous flooring from damage and wear during the remainder of construction period.

**3.3 EXAMINATION**

A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.

C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of materials to sub-floor surfaces.

D. Verify that concrete sub-floor surfaces are ready for flooring installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by flooring materials manufacturer.

E. Verify that required floor-mounted utilities are in correct location.

**3.4 PREPARATION**

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.
B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
C. Vacuum clean substrate.
D. Apply primer to surfaces required by flooring manufacturer.

**3.5 INSTALLATION - FLOORING**

A. Apply in accordance with manufacturer's instructions.
B. Apply each coat to minimum thickness required by manufacturer.
C. Finish to smooth level surface.
D. Cove (integral) at vertical surfaces where indicated on drawings.

**3.6 PROTECTION**

A. Prohibit traffic on floor finish for 48 hours after installation or longer if required by flooring manufacturer.
B. Barricade area to protect flooring until fully cured.

**END OF SECTION 09 67 00**

**SECTION 09 96 00**
**HIGH PERFORMANCE COATINGS**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to:
   1. All workmanship, materials, equipment, and quality requirements for lining work of concrete structures. Provide and apply all lining materials as specified, as indicated on drawings, and per Manufacturer's instructions design details. Areas to be coated are as follows:
      a. All new interior concrete surfaces of the Booster Pump Station.
      b. All newinterior and exterior steel surfaces of the Booster Pump Station.

B. General:
   1. Cleaning, surface preparation, coating application, and thicknesses shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the Manufacturer's minimum recommendations.

### 1.2 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301 - Specifications for Structural Concrete;
   2. ACI 308R - Guide to Curing Concrete

B. ASTM International (ASTM):
   1. ASTM D4285 - Standard Test Method for Indicating Water or Oil in Compressed Air
   2. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
   3. ASTM E337 - Standard Test Method for Measuring Humidity with a Psychrometer
   4. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

C. International Concrete Repair Institute (ICRI):
   1. Guideline No. 03732 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

D. NACE International (NACE):
   1. NACE Publication 6D-173 A Manual for Painter Safety;
   2. NACE RP0188 Standard Recommended Practice, Discontinuity (Holiday) Testing of Protective Coatings

E. SSPC: The Society for Protective Coatings (SSPC):
   1. SSPC-SP5/NACE No. 1 White Metal Blast Cleaning;
   2. SSPC-SP10/NACE No. 2 Near White Metal Blast Cleaning;
   3. SSPC-SP13/NACE No. 6 Surface Preparation of Concrete;
   4. SSPC-Guide 12 Guide for Illumination of Industrial Painting Projects;
   5. SSPC-PA3 A Guide to Safety in Paint Applications

### 1.3 DEFINITIONS

A. The term “coating” and “lining” as used herein are considered interchangeable and mean coating systems materials, including any applicable resinous primers and finish coats that function to provide protection of steel or concrete substrates.
B. The terms “coating system” and “lining system” as used herein are considered interchangeable and mean all total resurfacing and coating materials combined to function as a total system to provide the designed protection.

**1.4 SUBMITTALS**

A. General: Submit in accordance with Section 01 30 00.
B. Submit the following prior to commencing with any phase of the work covered by this Section:
   1. Manufacturer’s project reference lists containing a minimum of 10 projects of similar capacity within the last three (3) years. The reference list shall comprise of the project location, and coating system.
   2. Manufacturer’s current printed recommendations and product data sheets for all coating system products supplied under this section including surface preparation and application instructions, volatile organic compound (VOC) data, and safety requirements.
   3. Manufacturer’s Performance Criteria Data Sheet detailing product performance testing.
   4. Material Safety Data Sheets (MSDS) for any materials brought on-site including all solvents and lining system materials.
   5. Submit certification that all materials comply with Federal, State, and Local regulations for VOC (Volatile Organic Compounds).
   6. Submit storage and application temperature requirements for all coating system materials.
   7. Manufacturer’s recommended standard lining details for all materials specified, including: leading edge termination, metal embedment in concrete, termination at pipe penetration, control/construction joint, expansion joint detail, and wall to slab detail. All details must be computer generated by the coating Manufacturer and approved by the Engineer.
   8. Contractor shall submit list of projects of similar size and complexity along with names of tradesman and work experience employed by the Contractor.
C. Submit the following information at the completion of the work identified within the scope of this section:
   1. Submit daily reports that contain the following information: surface preparation, substrate conditions, ambient conditions, application procedures, coating materials used, coating material quantities, batch numbers of materials used, and work completed and location thereof. Mark-up drawings that show location of work.

**1.5 QUALITY ASSURANCE**

A. Requirements:
   1. If any requirements of this specification conflict with a referenced standard, the more stringent requirement shall apply.
   2. Do not use or retain contaminated, outdated, or diluted materials for coating operations. Do not use materials from previously opened containers.
   3. Make available all locations and phases of the work for access by the Engineer or other personnel designated by the Engineer. The Contractor shall provide ventilation and egress to safely access

the coating work areas for inspection.

4. Conduct work so that the lining system is installed as specified herein. Inspect work continually to ensure that the lining system is installed as specified herein. The Contractor shall inspect the work to determine conformance with the specifications and referenced documents. The Contractor shall inform the Engineer of the progress and the quality of the work through daily reports as specified below. Any nonconforming coating system work shall be corrected as specified herein or as recommended by the Manufacturer.
5. Summarize test data, work progress, areas covered, ambient conditions, quality control inspection test findings, and other information pertinent to the lining system installation in daily reports to be submitted to the Engineer.
6. The methods of construction shall be in accordance with all requirements of this specification.
7. Employ only tradespeople who have at least three (3) years of experience performing lining system work of similar size and complexity as the work specified in this Section. Submittals to verify these qualifications are to be made within thirty (30) days of the Notice-to-Proceed and are subject to approval by the Engineer.

B. Single Source Responsibility:
   1. All lining system materials, including resurfacing materials, primers, and applicable topcoats shall be products of a single manufacturer.

**1.6 DELIVERY AND STORAGE**

A. Materials shall be stored in accordance with Manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life recommended by the Manufacturer shall be removed from the site.

B. Store all materials only in area or areas designated by the Engineer solely for this purpose. Confine mixing, thinning, clean-up and associated operations, and storage of materials-related debris before authorized disposal, to these areas. All materials are to be stored on pallets or similar storage/handling skids off the ground in sheltered areas in which the temperature is maintained between 40° F and 90° F.

C. Mix all lining materials in an enclosed mixing area proposed by the Contractor and approved by the Owner. This enclosed area must protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination. Protect all other concrete and metallic surfaces and finishes from any spillage of material(s) within the mixing area. The material temperature should be between 70o F and 90o F prior to application, unless noted otherwise on the product data sheet.

D. Do not use floor drains, dikes or storm drains for disposal of coating system materials.

E. The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the resurfacing system materials as described on the pertinent Material Safety Data Sheets or container labels.

F. Deliver all materials to the jobsite in their original, unopened containers. Each container shall bear the Manufacturer's name and label.
   1. Labels on all material containers must show the following information:
      a. Name or title of product.
      b. Manufacturer's batch number and date of manufacture.

c. Manufacturer's name.
d. Generic type of material.
e. Application and mixing instructions.
f. Hazardous material identification label.
g. Shelf life date.
h. Storage requirements.

G. All containers shall be clearly marked indicating any personnel safety hazards associated with the use of or exposure to the materials.
1. All materials shall be handled and stored to prevent damage or loss of label.
2. Coating material storage and mixing areas shall be proposed by the Contractor and approved by the Owner.
3. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.

**1.7 PROJECT CONDITIONS**

A. Environmental Requirements:
1. For containment lining, concrete substrate shall have cured a minimum of 28 days utilizing a dissipating curing membrane (water). If a curing compound is used on the slab, it must be completely removed prior to application of final topping, and compound and removal system must be approved in writing by topping manufacturer. Concrete sub floors on or below grade shall be adequately waterproofed beneath and at the perimeter of the slab.
2. Proceed with containment lining Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dew point and other conditions comply with the containment lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.
3. Do not begin Work when relative humidity is expected to rise above 90 percent during the time of installation and catalyzation, nor when substrate temperature are not at least five degrees above the dew point temperature and rising.
4. Utilities, including electric, water, heat (air temperature between 65 degrees F and 90 degrees F), and finished lighting to be supplied by the general contractor.
5. Job area to be free of other trades during, and for a period of 24 hours, after lining installation.
6. Do not begin containment lining Work until manufacturer's recommended environmental conditions can be maintained and only when manufacturer and installer are willing to guarantee the Work as required and without additional reservations and restrictions.
7. Protection of finished walls and floor from damage by subsequent trade shall be the responsibility of the general contractor.

B. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminates during protective lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

**1.8 FIELD SERVICES**

A. Coatings manufacturer's representative shall inspect the surfaces to be coated and provide written acceptance of surface prep prior to the initial primer coating and written concurrence to proceed with each subsequent coating. The manufacturer's representative shall also provide written acceptance of the total final applied coating system.
B. Provide the above for each structure scheduled for the high performance coatings.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

A. Products of the Tnemec Company, Inc. are listed to establish a minimum standard of quality. Materials from other manufacturers will be reviewed and accepted if the materials are equivalent to the products listed.

**2.2 MATERIALS**

A. High-Performance Coating Materials:
   1. Epoxy Surfacer/Filler/Patcher to surface and repair concrete substrate and eliminate bug-hole induced outgassing: Tnemec Series 218 MortarClad
   2. High Solids Cycloaliphatic Amine Epoxy: Tnemec Series 61 Tneme-Liner
B. Sealants:
   1. Where directed, use a non-sag industrial Polysulfide Joint Sealant Thiokol 2235M manufactured by PolySpec, Houston, TX, or equal.
   2. The approved joint sealants shall be installed at joints and cracks in the concrete in conjunction with the coating material in accordance with the instructions and details of the Coating Manufacturer and as follows:
      a. All joints to receive sealant shall be cleaned, primed, backed and caulked in complete accordance with the sealant manufacturer’s instructions. Existing caulk joints and residual caulking where new caulk joints will be applied or where surfaces will be left exposed in the new work shall all be removed by grinding or other approved means to leave surfaces acceptable to receive sealant or clean as approved where surfaces will be left exposed. Provide specified backing rods for all joints or, where authorized, approved bond breaker tape.

**PART 3 EXECUTION**

**3.1 GENERAL**

A. Hoisting, Scaffolding, Staging and Planking:
   1. Provide, set-up, and maintain all required hoists, scaffolds, and staging and planking, and perform all access related hoisting work required to complete the work of this section as indicated and specified.
   2. Scaffolds shall have solid backs and floors to prevent dropping materials from there to the floors or ground below.
B. Environmental Requirements:
   1. Comply with the Manufacturer's recommendations as to environmental conditions under which lining system materials can be applied.

2. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with Manufacturer's instructions.
3. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above the dew point.
4. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with Manufacturer's instructions.
5. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
6. Wind: Do not spray coatings if wind velocity is above Manufacturer's limit or causes overspray of the coating materials.
7. Provide ventilation during and following coating application per the Manufacturer's instructions.
8. Ventilation must be maintained a minimum of 24 hrs following the completion of application to facilitate cure of the materials, or as directed by the Manufacturer.
9. Contractor shall provide all necessary artificial lighting in accordance with SSPC-Guide 12.

C. Protection:
1. Cover or otherwise protect finish work or other surfaces not being coated within the scope of this section.
2. Erect and maintain protective tarps, enclosures and/or masking to contain debris (such as dust or airborne particles resulting from surface preparation) generated during any and all work activities. This includes, but is not limited to, the use of dust/debris collection apparatus as required.

D. Initial Inspection of Surfaces to be Coated:
1. It is the responsibility of the Contractor to inspect and report unacceptable substrate surface conditions to the Engineer prior to the commencement of surface preparation activities.
2. Unacceptable concrete surface conditions are defined as the presence of water infiltration/inflow, cracked surfaces or concrete deteriorated to a depth of greater than 1" or otherwise unable to withstand surface preparation as specified herein.
3. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 9 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

E. Thinners and Solvents:
1. The Contractor shall use only solvents and thinners as recommended by the coating Manufacturer.

**3.2 SUBSTRATE PREPARATION**

A. Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that my inhibit bonding. Prior to start of protective lining systems application, high-pressure water clean, waterjet or abrasive blast surfaces to be covered as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6. Surface preparation procedures shall be in accordance with SSPC-SP13/NACE No. 6 and ICRI Guideline No. 310.2. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an ICRI-CSP 3 or greater.

B. All new cast-in-place and precast concrete shall cure for a period of 28 days in accordance with ACI 308R before protective lining system is installed, unless otherwise recommended by the Containment Lining manufacturer.

C. Concrete surfaces to receive protective lining shall be a Smooth Form Finish as defined in ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or

cover the firm substrate surface.

D. Level or grind concrete substrates to manufacturer's recommended tolerances and produce a smooth, uniform installation, including removal of all sharp edges, ridges, or depressions.

E. All surfaces must be clean, dry and free of oil, grease and other contaminants, prior to preparation in accordance with SSPC-SP13/NACE No. 6. Concrete surfaces must be sound and capable of supporting the protective lining system as determined by the engineer. Surface preparation requirement is to expose a sound, uniform surface texture conforming to the minimum recommended ICRI-CSP. The appropriate surface/filler/patcher shall be applied to the prepared surface to condition the substrate making suitable for protective lining system.

**3.3 SYSTEM INSTALLATION**

A. All surfaces shall be surfaced, filled or patched utilizing Series 218 MortarClad to fill all bugholes, spalls, cracks and other surface defects prior to the installation of the containment lining system.

B. To all horizontal and vertical surfaces, apply a uniform prime coat of Series 61 Tneme-Liner at 8.0 - 12.0 mils DFT.

C. To all horizontal and vertical surfaces, apply a uniform finish coat of Series 61 Tneme-Liner at 8.0 - 12.0 mils DFT.

D. Saw cuts - All areas where the installed lining does not transition into another surface of a different angle shall be saw cut. The saw cut shall be ¼" wide by a ¼" in depth.

E. Expansion and Control Joints - Where specified, a joint shall be saw-cut after the lining installation and filled with a flexible epoxy or urethane sealant.

F. Application in direct sunlight and/or with rising surface temperature is not allowed, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling.

G. Areas not to receive containment lining shall be masked or otherwise protected to prevent these surfaces from being coated.

H. Ensure straight, even termination of protective lining system on wall edges and flush with embedded steel.

**3.4 FIELD QUALITY CONTROL, INSPECTION, AND TESTING**

A. Inspection by the Engineer or others does not limit the Contractor's responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

B. Contractor and his Installer shall examine the areas and conditions under which the containment lining Work is to be performed in accordance with SSPC-SP13/NACE No. 6 and notify Engineer in writing of conditions deleterious or otherwise detrimental to the proper and timely completion of the work.

C. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Installer, and will produce a finished product meeting the requirements of the Specifications. All defects resulting from such accepted conditions shall be corrected by Contractor at his own expense.

D. Dry-Film Thickness:

1. Wet-Film Thickness shall be taken every 100 square feet in accordance with ASTM D 4414 and recorded.

2. The Dry-Film Thickness can be determined using surface area calculation for material consumption.

**3.5 ACCEPTANCE CRITERIA**

A. All surfaces shall be prepared in accordance with the specification and referenced standards herein.

**3.6 ADJUSTMENTS AND CLEANING**

A. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.

B. Clean all surfaces not designated to receive protective lining. Restore all other work in a manner acceptable to Engineer.

C. Provide non-staining protective construction paper as approved over the entire surface area, with joints taped, and boards or planks where subjected to especially heavy traffic or hazards.

D. All finished protective lining shall be protected from damage until Final Acceptance of the Work. Protective lining damaged in any manner shall be repaired or replaced at the discretion of Engineer, at no additional cost to Owner.

E. Clean all protective lining as recommended by the manufacturer to provide finished Work acceptable to Owner just prior to Final Acceptance.

**END OF SECTION 09 96 00**

**SECTION 10 14 00**
**SIGNAGE**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Room and door signs.

### 1.2 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

### 1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
F. Manufacturer's Qualification Statement.

### 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

### 1.6 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain this minimum temperature during and after installation of signs.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Flat Signs:
    1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
    2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com/#sle.
    3. Inpro: www.inprocorp.com/#sle.
    4. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.

**2.2 SIGNAGE APPLICATIONS**

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
   1. Sign Type: Flat signs with engraved panel media as specified.
   2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
   3. Character Height: As required by code.
   4. Symbol Height: As required by code.
   5. Service Rooms: Identify with the room names and numbers indicated on drawings.
   6. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers indicated on the drawings, and braille.

**2.3 SIGN TYPES**

A. Flat Signs: Signage media without frame.
   1. Edges: Bevelled.
   2. Corners: Radiused.
   3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:
   1. Character Font: Helvetica, Arial, or other sans serif font.
   2. Character Case: Upper case only.
   3. Background Color: To be selected from manufacturer's full color line.
   4. Character Color: Contrasting color.

**2.4 ACCESSORIES**

A. Tape Adhesive: Double sided tape, permanent adhesive.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that substrate surfaces are ready to receive work.

**3.2 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Substantial Completion; repair or replace damaged items.

**END OF SECTION 10 14 00**

**SECTION 10 44 00**
**FIRE PROTECTION SPECIALTIES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Fire extinguishers.
B. Accessories.

### 1.2 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide Current Edition.
B. NFPA 10 - Standard for Portable Fire Extinguishers 2022.
C. UL (DIR) - Online Certifications Directory Current Edition.

### 1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features.
C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

### 1.4 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. Ansul, a Tyco Business: www.ansul.com/#sle.
   2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
   3. Nystrom, Inc: www.nystrom.com/#sle.
   4. Potter-Roemer: www.potterroemer.com/#sle.
   5. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
   6. Strike First Corporation of America: www.strikefirstusa.com/#sle.

### 2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound.
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 40 degrees F to 120 degrees F.

**2.3 ACCESSORIES**

A. Extinguisher Brackets: Formed steel, chrome-plated.
B. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

**3.2 INSTALLATION**

A. Install in accordance with manufacturer's instructions.
B. Secure rigidly in place.
C. Place extinguishers on wall brackets.

**END OF SECTION 10 44 00**

**SECTION 20 00 00**
**COMMON WORK RESULTS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Plumbing work shall include all final connections and flexible connections to the plumbing system and to related equipment by other, as well as, connections serving the plumbing systems (site connections, make-up water connections, indirect waste connections, etc.).
B. Mechanical / HVAC work shall include all final connections and flexible connections to the mechanical / HVAC system and to related equipment by others, as well as, connections to external systems and mechanical / HVAC systems (site connections, make-up water connections, indirect waste connections, etc.).

### 1.2 RELATED REQUIREMENTS

A. Division 01 - General Requirements.
B. Section 01 30 00 - Administrative Requirements.
C. Section 01 51 00 - Temporary Utilities.
D. Section 01 78 00 - Closeout Submittals.
E. Division 03 - Concrete.
F. Division 05 - Metals.
G. Section 07 90 05 - Joint Sealers.
H. Section 09 90 00 - Painting.
I. Section 20 10 05 - Piping.
J. Division 31 - Earthwork.

### 1.3 REFERENCE STANDARDS

A. ASHRAE 15 - American Society of Heating Refrigeration and Air-Conditioning Engineers.
B. ASHRAE 34 - American Society of Heating Refrigeration and Air-Conditioning Engineers.
C. ASME (BPV) - Boiler and Pressure Vessel Code; American Society of Mechanical Engineers; 2013.
D. ASME B18.10 - Standard for Bolt and Nuts.
E. ASTM A36 - Standard Specification for Carbon Structural.
F. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts.
G. ASTM A307 - Carbon Steel Bolts and Studs.
H. ASTM C881 - Standard Specification for Steel Wire.
I. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use , carbon steel, plain, steel, washers.
J. AWS D1.1 - Structural Welding Code--Steel.
K. AWWA C651 - Disinfection of Water Mains.
L. AWWA C652 - Disinfection of Storage Facilities.
M. CFR 58 - Code of Federal Regulations Section 58.
N. NFPA 72 - National Electric Code, National Fire Protection Association.
O. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

### 1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Submittal Naming: Submittals shall be identified through a numbering system. Throughout Division 20, 21, 22 and 23, submittal numbers are proposed for the mandatory submittals. The numbers are (## ## ## - ### - L).
   1. ## ## ## Is the section number or drawing number referenced for the submittal.
      a. A specification section would be referenced using all of the number for the spec section, it is not limited to just 6 digits.
      b. A drawing would be referenced as MH601.
   2. - indicated a hyphen at the end of the section or drawing number.
   3. ### a three number series. The first number is the contractor number. The next two numbers in the sequential number for the submittal for that section.
      a. 0## - use through Division 20, 21, 22 and 23, for proposed number, contractor responsible for work to change when submitting.
      b. 2## - Plumbing Contractor.
      c. 3## - Mechanical Contractor.
   4. - indicated a hyphen at the end of the three number series.
   5. L Starting with an A for the first submittal. Each re-submittal shall increase to the following letter.
C. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
D. Coordination Forms: Provide signed copies of all coordination form and exterior applications for services.
   1. Domestic Water - Submit copy of application to owner and utility company.
   2. Sanitary Sewer - Submit copy of application to owner and utility company.
E. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Pipe portals (20 00 00 - 003 - A)
F. Shop Drawings: Indicate materials used, jointing methods, supports, floor, and wall penetration. Indicate installation, layout, weights, mounting and support details, and connections.
   1. Pipe portals (20 00 00 - 003 - A)
G. Project Record Documents: Record actual installed locations of components and tag numbering.
   1. Refer to Section 01 78 00 - Closeout Submittals.
   2. Record Documents (20 00 00 - 005 - A)
H. Operation and Maintenance Data: Include installation instructions and spare parts lists.
   1. Refer to Section 01 78 00 - Closeout Submittals.
   2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
   3. Operation and Maintenance DVD (20 00 00 - 007 - A)

## 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
   1. Submittal of documented experience, submitted upon request by Engineer.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience. Submittal of documented experience, submitted upon request by Engineer.
   2. Approved by manufacturer. Submittal of approval, submitted upon request by Engineer.
C. Conform to UL, FM, and Warnock Hersey requirements.
D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

**1.6 DELIVERY, STORAGE, AND HANDLING**

A. Deliver and store products in shipping containers, with labeling in place.
B. Provide temporary protective coating on products.
C. Provide temporary end caps and closures on duct, piping, equipment and fittings. Maintain in place until installation.
D. Protect products from weather and construction traffic, dirt, water, chemical, and mechanical damage.
E. Protect installed fixtures and equipment from damage by securing areas and by leaving factory packaging in place to protect equipment and fixtures and prevent use of equipment and fixtures.

**1.7 CODES AND STANDARDS**

A. Work is subject to provisions of the International Building Code and has been designed to be in compliance with the Code. Design aspect of the Project shall not be altered regarding building envelope or selection of HVAC, service water heating systems and equipment. Supplemental data published by equipment and system manufacturers to substantiate energy conservation efficiencies throughout the Project shall be furnished at request of Engineer.
B. Work shall meet requirements of the FM Global, National Fire Protection Association, all Federal, State, and Municipal authority's laws, rules and regulations applicable to the Work and public utilities having jurisdiction over systems specified herein.
C. Domestic Water Heater(s), Heating Equipment, and Pressure Vessels shall be constructed and tested in accordance with recommendations of the National Fire Protection Association and ASME BPV code.
   1. Equipment shall be stamped with the ASME symbol and National Board number and shall be inspected during construction by an inspector who has been commissioned by the Maryland Department of Labor and Industry to perform such service. Equipment shall be prepared for initial inspection in accordance with Department of Labor and Industry regulations.
D. Plumbing Work shall be installed in conformity with applicable portions of the ASME Plumbing Code, International Plumbing Code, State Plumbing Codes, and Local Ordinances and shall be approved as project progresses by local authority having jurisdiction.
E. Nothing in the Specifications shall be construed to permit deviation from requirements of any governing code(s).
F. The handling and use of CFC and HCFC refrigerants, whether leaking, venting, recovering, etc., shall be in accordance with US Environmental Protection Agency regulations CFR 58 FR 28660, ASHRAE 15-1994-Safety Code for Mechanical Refrigeration, and ANSI/ASHRAE 34-1997-Number Designation and Safety Classification of Refrigerants.
G. Electrical Work shall meet requirements of the National Electrical Code and all Federal, State, and Municipal authority’s laws, rules and regulations applicable to the Work.

H. Where applicable, materials and equipment shall bear the label of approval of Underwriters Laboratories, Inc.

I. Reference to codes and standards listed herein shall constitute minimum acceptable requirements. Where Drawings and Specification requirements exceed those of codes listed, Drawings and Specifications shall take precedence for Work of this Project.

J. If Contractor, during the course of work, observes the existence of hazardous materials in the structure or on the project site, Contractor shall promptly notify Owner and Engineer. Contractor shall not perform any work pertinent to the hazardous material prior to receipt of special instructions from Owner. “Hazardous materials”, for the purpose of this Specification, are defined as but not limited to asbestos, PCB’s, petroleum, radioactive material, or any substance classified as hazardous waste substances.

**1.8 SUBSTITUTIONS**

A. Specifications for each piece of equipment and each item of material are written around a product of a specific base manufacturer. This base manufacturer is the basis of design, dimensions and details. The base manufacturer’s name and model information are included with the product description as the first named manufacturer under the heading “Acceptable Manufacturer”.

B. “Substitution” manufacturers are defined as any manufacturer other than the one used as the basis of design. “Substitution” manufacturers will be permitted, in accordance with the bidding requirements and where indicated herein.

C. Manufacturers named in the product description, in addition to the base manufacturer, are “substitution” manufacturers, have been determined to be manufacturers capable of manufacturing products similar to the base manufacturer and these manufacturers are acceptable “substitution” manufacturers to the base manufacturer. Where additional manufacturer’s names do not appear with the base manufacturer, the Engineer reserves the right to disallow any “substitution” manufacturers. Where the base manufacturer’s name is followed by the term “no substitution”, no “substitution” manufacturers will be considered.

D. Naming of specific manufacturers shall not be construed as eliminating products or services of other “substitution” manufacturers having comparable items. Where permitted by these Specifications, and where Bidder desires to use other “substitution” manufacturers, he may submit a request for approval to use the “substitution” manufacturer in accordance with bidding requirements.

E. Products described in Specifications are intended to set a quality level and ensure a workable system. “Substitution” of manufacturers, including those herein named, may be made only after approval of Engineer. Bidder shall assume full responsibility for installation and dimensional changes required by the use of all “substitution” manufacturer’s products, including revisions to wiring, controls, piping, structural revisions, etc., and all room or space changes as required due to dimension differences of the “substitution” manufacturer product. Engineer approval of “substitution” manufacturer’s products shall be limited to compliance with information given on the Drawings and Specifications.

**1.9 COORDINATION - UTILITIES**

A. Domestic Water:

1. Coordinate connection of domestic water systems with local utility company.

a. Submit all required forms and requested information to utility company for application for service.
b. Coordinate on-site with local utility representative for pathways and requirements.

2. Connect cold water piping to water-service piping for service entrance to building.
3. Comply with requirements for exterior piping. Refer to section 20 10 05 - Piping.
4. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
5. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

B. Sanitary Sewer:

1. Coordinate connection of sanitary systems with local utility company.
   a. Submit all required forms and requested information to utility company for application for service.
   b. Coordinate on-site with local utility representative for pathways and requirements.
2. Connect sanitary piping to sewer piping for service entrance to building.
3. Comply with requirements for exterior piping. Refer to section 20 10 05 - Piping.
4. Install house trap, bi-directional cleanouts, vents and other accessories at connection to sanitary-service piping.

**1.10 COORDINATION - SERVICE INTERRUPTION**

A. Interruption of Existing Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service.

1. Do not interrupt water service without Owner's written permission.
2. Notify owner in writing, 10 days prior to service interruption. Notification must include the following:
   a. Date and time for start of service interruption.
   b. Utility company involvement, if required.
   c. Itemization of each utility services impacted.
   d. Work to be performed.
   e. Time and duration of anticipated service interruption.
   f. Arrangement of temporary service for anticipated shutdown.
   g. Arrangement of temporary service for shutdown extending beyond shutdown time.
3. Submit as RFI for approval.

**1.11 COORDINATION - GENERAL**

A. Work shall be governed by requirements set forth in the conditions of the Contract.
B. Provide all labor, materials, and equipment required by the Contract Documents necessary for completion of the Work.
C. Bidders shall visit the project site to determine actual conditions which will be encountered in completing the work of this project.
D. Drawings are generally indicative of work to be installed but may not indicate all bends, fittings, elbows, etc., required to meet conditions. Where items shown on the Drawings, or herein described, are not clearly understood, Bidders shall confer with Engineer.

E. Coordinate Work of Division 20, 21, 22 and 23 with that of other trades so that work will be installed in the most direct manner and so that interference between piping, ducts, conduits, equipment, and architectural or structural features will be avoided. Work installed in an arbitrary manner without regard for work of other trades or equipment servicing requirements will be rejected in any situation where an undesirable condition or an unfair hardship for other trades, or Owner, results. Removal of installed work and installation of re-work will not be charge to owner, Work shall be at the expense of Contractor.

F. Provide sufficient scaffolding and hoist or rig material and equipment into place, or arrange for rigging by others. In any case, rigging or hoisting for Work shall be at the expense of Contractor.

G. Unless otherwise indicated on the Drawings, provide structural steel members as required for support of equipment and materials furnished under Division 20, 21, 22 and 23. Provide all hangers and supports, as specified, detailed, or in accordance with accepted industry standards.

H. Equipment shall be installed in accordance with equipment manufacturer's installation instructions unless otherwise required by code or specific instructions. Obtain manufacturer's installation instructions prior to roughing-in.

I. Where equipment is furnished by other trades for installation as Work under this Contract, or where electrical service or utility connection to equipment installed by others is indicated as Work of this Contract, obtain approved shop drawings and installation instructions from the respective contractor prior to roughing-in. Discrepancies between installation instructions and Contract Documents shall be brought to the attention of Engineer.

J. Where equipment is indicated to be furnished as Work of this Contract for installation by others, or where equipment furnished and installed under this Contract requires utility connections by others, provide to the respective contractor one copy of an approved shop drawing and installation instructions necessary for execution of his work.

K. Unless specifically indicated, communication between the mechanical and electrical systems equipment and panels shall be via a dedicated wiring system furnished and installed by the systems installers. These systems shall be separate from all other data communication networks within the building. Contractor may request approval for providing communications on the Owner's building data network. If Owner's written approval is obtained, the system installer shall fully coordinate the necessary data network connections with the Owner, the Owner's technology consultant, and the contractor responsible for installing the building data network system.
    1. The systems shall follow the Owner's data network labeling scheme for outlets and jacks, operation protocols, and shall adhere to all network security measures.
    2. The system installer shall be responsible for all costs associated with equipment, materials, and labor necessary to furnish and install the communications network including, but not limited to: jacks, wall plates, cables, conduits and boxes, patch panels, patch cords, additional Owner switches and equipment, additional systems equipment and programming services.
    3. Bid shall include no connections.
    4. Submit as RFI with credit.

**1.12 COORDINATION - NEW CONSTRUCTION**

A. Openings and recesses, including cutting, patching and finishing, necessary for installation of Work of this Contract in new construction will be provided by General Contractor. Coordinate locations,

dimensional data, and scheduling of Work with General Contractor.

B. Where piping is run concealed in concrete masonry unit (block) walls, Contractor shall be responsible for installing his work in cores of block for mason to wall-in as he carries up wall. Coordinate locations and scheduling of Work with General Contractor.

C. General Contractor will provide concrete foundation pads for mechanical and plumbing equipment. Provide General Contractor with approved shop drawing, dimensional data for size of base, and insert and anchor bolt locations. Method of setting, aligning, and anchoring shall be as recommended by equipment manufacturers. Unless noted otherwise, foundations shall be 6 inches above finished floor and extend a minimum of 6 inches beyond base or bed plate.

**1.13 COORDINATION - BASIS OF DESIGN**

A. 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.

1. Refer to the General Conditions and Division 01 Specification Sections for the requirements of product substitution.
2. Where more than one manufacturer is named, only the first named manufacturer's item has been verified as suitable.

**1.14 COORDINATION - ELECTRICAL PANELS**

A. Indicate all electrical, IT, telecommunication and data rooms at 1/4"=1 foot scale.

1. Highlight any piping or ductwork which crosses above an electrical panel, box or piece of equipment without another barrier between the elements.

B. Coordination between trades and final room layout is to be provided.

1. Where possible, piping and ductwork shall not be installed above electrical panels, transformers or devices.
2. Coordination between the trades shall ensure equipment locations and piping / ductwork locations are not in direct conflict.
3. Install penetrations through walls to the sides of panels or above doorways where possible.

C. Where piping or ductwork is placed directly above an electrical panel, transformer or equipment, a secondary containment pan shall be provided.

1. Drain pans shall be constructed of galvanized sheet metal.
2. Drain pans shall overextend beyond pipe / ductwork by 6" in each direction with a 1.5" minimum depth.
3. Drain pans shall have a 1" drain connection extended to an indirect drain, mop receptor, or floor drain. Tag drain pipe with label for drain pan and location.
4. Drain pan shall have a water sensor. Furnish and install water sensor and light / horn. Upon water being sensed, light and horn shall be energized. Alarm shall be tied to Building Automation System where Building Automation System is provided.
    a. Water sensor Rectorseal Series AG-1250E.

b. Alarm Rectorseal Series AG-9100.
c. Power source Hammond Mfr. Series BPE2G.

**1.15 COORDINATION - DISCONNECTS STARTERS AND VFD DRIVES.**

A. Disconnect starters and VFD drives shall be provided as indicated on the contract documents.
B. Where a disconnect, starter and or a VFD drive is indicated as provided as factory wired and provided for a piece of equipment, if the disconnect, starter and or a VFD drive is provided as a "loose" shipment or not installed on the equipment, the contractor supplying the piece of equipment shall be responsible to mount the disconnect, starter and or VFD drive. The power wiring between the disconnect, starter and or a VFD drive and the component is to be provided by the contractor supplying the piece of equipment. The power wiring shall be in the same size and type serving the disconnect starter and or a VFD drive. The power wiring shall be in similar assembly of conduit and wire type as indicated in division 26 and serving the disconnect starter and or VFD drive.
C. Disconnects shall be suitable for use as an OSHA lockout/tagout disconnect when applied in accordance with part IV, Department of Labor OSHA 29 CFR part 1910.
D. Disconnect handles can be padlocked in the "off" position with up to three padlocks. Switch mechanism can be directly padlocked in the "off" position when the door is open.

**1.16 COORDINATION - ROOFING**

A. Plumbing Contractor shall furnish pipe portals and vent flashing as indicated in part 2 of this section.

**1.17 EXCAVATION AND BACKFILL**

A. Perform excavation and backfill required for Work under Division 20, 21, 22 and 23, inside and up to 5 feet outside building. Excavation and backfill shall be in accordance with requirements set forth in Division 31.
B. Work shall include saw cutting, trenching, backfilling, patching, repairing and reseeding of all areas disturbed by excavation.
C. Banks and excavations shall be retained by means of shoring and braces to avoid cave-ins. Shoring shall be in accordance with state and local regulatory agencies' requirements. Shoring shall be maintained until installation, tests and inspections are complete.
D. Pumping equipment shall be provided and maintained to pump water from excavations.
E. Comply with applicable regulations regarding identification and location of existing underground utility lines prior to excavation.

**1.18 PAINTING**

A. Furnished equipment that is pre-painted or pre-finished by manufacturer shall have all nicks, scratches, blemishes, and rust spots cleaned, primed, and refinished prior to final acceptance by Owner.
B. Painting shall be in accordance with the section 09 90 00 - Painting and Coating.
C. General Contractor will paint exposed unfinished equipment, piping, ductwork, etc., unless noted otherwise.
D. Prime and paint exposed unfinished equipment, piping, ductwork, supports and miscellaneous steel installed in finished areas in color selected by Architect.

**1.19 FIELD CONDITIONS**

A. Refer to Section 01 51 00 - Temporary Utilities.
B. Maintain ambient temperatures and conditions required by manufacturers of products for the installation of materials. Including but limited to the following: adhesives, mastics, cements, paints and plastics.
C. Maintain ambient temperatures and conditions required by the system until the permanent means of protection is active. Including but limited to the following: freeze protection of water or fluid filled coils, piping or equipment.
D. Do not excavate or backfill when ground is saturated or frozen.

**1.20 PERMIT AND FEES**

A. Refer to Section 01 00 00 - General Requirements.
B. Secure all permits and inspections required by applicable authorities and utilities and pay all costs in connection with the Work.
C. Schedule all inspections required by applicable authorities and utilities. Certificates shall be in triplicate and shall be delivered to Owner.
D. Piping work, specialties, or equipment shall not be concealed or covered until same have been tested and inspected by municipal inspector(s) and observed by the professional. Municipal inspector(s) record of inspections shall be delivered to Owner. The professional and municipal inspector's witnessing of tests shall not relieve Contractor of his responsibility for concealed piping work and specialties, nor for equipment to perform in accordance with Contract Documents.

**1.21 FAULTY WORK**

A. Refer to Section 01 00 00 - General Requirements.
B. If Engineer is required to make extensive visits to the site to investigate defective or incomplete Work by Contractor, a Change Order will be issued to the Contractor for a credit due on the Contract Price to recoup expenses. Defective Work, as used here, refers to Work that is unsatisfactory, faulty, or deficient, or does not conform to Contract Documents, or does not meet requirements of any inspection, test, or approval referred to in Contract Documents, or has been damaged prior to Engineer's recommendation of final payment. An appropriate and reasonable charge will be allowed for Engineer's direct and indirect expenses, in accordance with his normal rates, for Engineer's assistance in correcting defective Work.
C. If Engineer is requested or required, for any reason, to visit the site and make extensive or exhaustive inspections and if Work is found to be defective (as defined above), an appropriate and reasonable charge will be made by Mechanical Engineer to Owner. Contractor is liable for these charges under his continuing obligation (as described above).
D. If Work is found to be not defective Contractor will not be liable for Engineer's charges.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Refer to Section 01 00 00 - General Requirements.
B. All materials and equipment shall be new, without imperfections or blemishes, and shall be protected from the elements prior to installation.

C. Maintain ambient temperatures and conditions required by manufacturers of products for the installation of materials. Including but limited to the following: Adhesives, mastics, cements, paints and plastics.

**2.2 JOINT SEALANT**

A. Refer to specification 07 90 05 - Joint Sealers.

**2.3 CONCRETE**

A. Refer to Division 03.

**2.4 PIPE PORTALS**

A. Construction: 18 gage galvanized steel, unitized construction with integral base plate.
B. Standard Features:
   1. 12" tall above finished roof surface.
   2. Built in raised cant.
   3. Wood nailer.
   4. 3 lb. density insulation.
   5. Acrylic clad ABS plastic cover, fastening screws, graduated step boots with stainless steel clamps.

**2.5 VENT FLASHING**

A. Flash vent penetrating roofs with 6 lb. seamless sheet lead of sufficient size to extend a minimum of 10 inches into roofing felts and for membrane roofing systems.

**2.6 ANCHORS**

A. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
B. Washers: ASTM F 844, steel, plain, flat washers.
C. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
   1. Stainless-steel studs are available.
   2. Stud: Threaded, zinc-coated carbon steel.
   3. Expansion Plug: Zinc-coated steel.
   4. Washer and Nut: Zinc-coated steel.
D. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
   1. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   2. Stainless-steel studs are available.
   3. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
   4. Washer and Nut: Zinc-coated steel.

**2.7 STEEL**

A. Steel Shapes and Plates: ASTM A 36/A 36M.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Install work according to the following:
   1. Federal, State and Local codes.
   2. Manufacturer's recommendations.

B. Work shall be installed by mechanics skilled in the trade involved.

C. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide 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 over 4 inches.
   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 above slab.

D. Coordinated Installation:
   1. All equipment and materials shall be installed to allow access to and to facilitate service, maintenance, repair, replacement, etc., of components to all equipment furnished and installed under this Contract, furnished and installed under all other Divisions of the specifications, and, where applicable, Owner furnished and installed and Owner’s existing equipment.
   2. Ductwork, piping, equipment, etc., shall be installed in such a manner as to preserve access to equipment.
   3. Route ductwork and piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
   4. Install ductwork and piping to conserve building space, to not interfere with use of space and other work.
   5. Group ductwork and piping whenever practical at common elevations.
   6. Do not penetrate building structural members unless indicated.

E. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Install per UL listing.

F. Pipe Portals:
   1. Pipe portals provided as Work of this Section shall be coordinated with roof type. Shop drawing submittals for pipe portals, with, or without cants will be considered compatible with existing roof type.
   2. Pipe portals provided as Work of this Section shall be coordinated with requirements of roofing subcontractor. Shop drawing submittals for pipe portals, with or without cants will be considered in compliance with roofer's requirements.

G. Concrete and Grout:
   1. Construct concrete equipment bases of dimensions indicated, but not less than 6 inches larger than supported unit in both directions and minimum of 6 inches in thickness unless otherwise indicated. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations.
   2. Place grout on concrete bases to provide a smooth bearing surface for equipment.

3. Place grout around anchors.
4. Cure placed grout according to manufacturer's printed instructions.

H. Erection of Metal Supports and Anchorage:
1. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
2. Field Welding: Comply with AWS D1.1 - Structural Welding Code--Steel.
3. Comply with the requirements specified in Division 05.

I. Utility Services:
1. Water Service:
a. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each water-service entrance.

**3.2 CLEAN-UP**

A. Upon completion of Work, remove all dirt, foreign materials, markings, stains, fingerprints, etc., from all parts and equipment.
B. Remove all construction debris and vacuum interior spaces of all compartmental equipment.
C. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations and anti-pollution laws.
D. Work shall be subject to inspection by the Engineer.

**3.3 SYSTEM FLUSHING AND TESTING**

A. Domestic Water system shall be flushed with water and tested to 125 PSI.
1. Clean and disinfect potable domestic water piping as follows:
a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
b. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
2) Fill and isolate system according to either of the following:
(a) 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.
(b) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
3) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
4) Repeat procedures if biological examination shows contamination.
5) Submit water samples in sterile bottles to authorities having jurisdiction.
2. Clean non-potable domestic water piping as follows:
a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

b. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
   2) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

3. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
4. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Sanitary Sewer:
1. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   a. 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.
   b. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   c. 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-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   d. 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.
   e. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   f. Prepare reports for tests and required corrective action.

**3.4 DUST AND DEBRIS**

A. During construction all openings in piping shall be kept closed except when actual work is being performed on those items. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.
B. During construction all equipment shall be kept closed except when actual work is being performed on those items. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.
C. During construction all ducts shall be kept closed except when actual work is being performed on those items. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.

D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

**3.5 START-UP**

A. Submit proposed start-up checklist and proposed start-up dates for Owner and Engineer review 14 days prior to start-up.
   1. Start-up shall be included for all equipment that is scheduled and has either an electrical connection or fuel connection.

B. Start-up shall be provided for all equipment and systems.
   1. Start-up for equipment shall be performed by:
      a. Installing Contractor:
         1) For equipment with 120 volt and less than 20 amp load electrical connection or less than 100 MBH fuel connection.
      b. Factory Authorized Personnel:
         1) For equipment with 120 volt electrical connections or less than 400 MBH fuel connection.
      c. Factory Field Personnel:
         1) For equipment greater than 120 volt electrical connection or greater than 400 MBH fuel connection.
   2. Start-up for systems shall be performed by:
      a. Installing Contractor:
         1) For all systems not listed under 1.b and 1.c above.
      b. Factory Authorized Personnel:
         1) Regulator manufacturer shall start-up all gas systems above 7 psi.

C. Report:
   1. Submit report to Owner within 10 days of completion of start-up.
   2. Report shall include:
      a. Location / System / Equipment Tag.
      b. Names of Technicians performing Start-up.
      c. Indicate if Technicians are factory Authorized Personnel or Factory Field Personnel.
      d. Names of Witnesses.
      e. Start-up Checklist / Information in each start-up section.
      f. List of all set points and initial settings.
      g. Pressure test results.

**3.6 TRAINING**

A. Owner-Personnel Training: Owner will designate personnel to be trained in operation and maintenance of the systems.
   1. Obtain Owner's approval of training dates.
   2. Training sessions will be scheduled by Owner.
   3. Submit proposed training agenda for Owner's review and approval at least 30 days prior to start of training.

B. Training Agenda: Include the following:

1. Overview of system operation.
2. Overview of system equipment and device locations.
3. Manual controls.
4. Manual operation, testing and maintenance of devices.
5. Location of safety devices and resets.
6. User operation of control panel (alarm acknowledgement, alarm silence, reset, alarm resound).
7. Draining and filling procedures for the system.
8. Review of the Operation and Maintenance Manual.
9. Detailed maintenance procedures.
10. Periodic testing procedures.

C. Training Instructor:
   1. The following persons are authorized to provide training:
      a. Installing Contractor.
      b. Factory Authorized Technician.
      c. Factory Start-Up and Training Personnel.

D. Video Recordings:
   1. Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   2. At beginning of each training module, record each chart containing learning objective and lesson outline.
   3. Provide high quality color video recordings with menu navigation in format acceptable to Engineer.
   4. Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
   5. Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
   6. Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
   7. Provide video recordings used as a component of training modules in same format as recordings of live training.

**3.7 EXTENDED WARRANTIES**

A. Where extended warranties beyond the normal one year warranty are, as specified herein, to be applied to a particular item of equipment or system, furnish to Owner a description of the warranty along with any required registration and signature of manufacturer's authorized personnel.

B. Contractor shall be responsible for coordinating with and having the manufacturer administer these warranties for the full extent of time the warranty will be in effect.

C. Contractor shall be responsible for administering and servicing all extended warranties for the life of each extended warranty at no additional cost to Owner. Owner's responsibility will be for additional costs for parts associated with warranties that are warranted on a pro-rated basis. All labor for administering and servicing the extended warranty, including actual replacement of parts, will be the responsibility of the Contractor for the extended warranty period. All unwarranted shipping and

handling costs for parts and equipment will be the responsibility of the Owner.

**END OF SECTION 20 00 00**

**SECTION 20 05 13**
**COMMON MOTOR REQUIREMENTS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Single phase electric motors.
B. Three phase electric motors.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
C. Section 26 05 83 - Wiring connections.

### 1.3 REFERENCE STANDARDS

A. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers; 2004.
B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.
C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

### 1.4 SUBMITTALS

A. Start-up Report: Indicate start-up results verifying nominal efficiency, voltages and current.
   1. Refer to section 20 00 00 - Common Work Results.
   2. Submit as part of individual equipment start-up reports.

### 1.5 SUBMITTALS

A. Start-up Report: Indicate start-up results verifying nominal efficiency, voltages and current.
   1. Refer to section 20 00 00 - Common Work Results.
   2. Submit as part of individual equipment start-up reports.
B. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
D. Operation Data: Include instructions for safe operating procedures.

## PART 2 PRODUCTS

### 2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 40 degrees C environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
C. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

**2.2 APPLICATIONS**

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
B. Single phase motors for shaft mounted fans: Split phase type.
C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
D. Single phase motors for fans and pumps: Capacitor start type.
E. Motors located in outdoors and wet environments: Totally enclosed weatherproof epoxy-treated type.

**2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

A. Cannot be connected to VFD.
B. Starting Torque: Less than 150 percent of full load torque.
C. Starting Current: Up to seven times full load current.
D. Breakdown Torque: Approximately 200 percent of full load torque.
E. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
F. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

A. Can be connected to VFD.
B. Starting Torque: Exceeding one fourth of full load torque.
C. Starting Current: Up to six times full load current.
D. Multiple Speed: Through tapped windings.
E. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

**2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS**

A. Starting Torque: Three times full load torque.
B. Starting Current: Less than five times full load current.
C. Pull-up Torque: Up to 350 percent of full load torque.
D. Breakdown Torque: Approximately 250 percent of full load torque.
E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.6 DC ELECTRIC COMMUTATION TYPE MOTOR (ECM)**

A. Permanently lubricated with heavy duty ball bearings to match full load. Pre-wired to the specific voltage and phase with internal power conversion from ac to dc power.
B. Motor shall be controllable down to 20% of full speed with a 0-10 volt DC signal. Motor shall be 85% efficient at all speeds.

**2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

A. Starting Torque: Between 1 and 1-1/2 times full load torque.
B. Starting Current: Six times full load current.
C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
E. Insulation System: NEMA Class B or better.
F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine if free from electrical or mechanical defects in compliance with performance data.
G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13 - Enclosed Controllers.
I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
J. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.
D. Confirm rough-in location and signals before reough-in installation. Refer to section 23 09 13 - Instrumentation and Control Devices for HVAC.

**3.2 EXAMINATION**

A. Verify that surfaces are suitable for installation.
B. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
C. Verify that piping and equipment are ready to receive work.

D. Verify field measurements are as shown on shop drawings.
E. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
F. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
G. Maintain clearances to combustibles and service clearances.
H. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 INSTALLATION

A. Install in accordance with the following:
   1. Federal, State and local requirements.
   2. National Electric Code requirements.
   3. Manufacturer's Instructions.
   4. NFPA 70.
B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
C. Check line voltage and phase and ensure agreement with nameplate.

## 3.4 START-UP

A. Perform start-up in accordance with Section 20 00 00 - Common Work Results.
B. Verify system is ready for start-up with visual inspection and sign off from installing personnel.
C. Start-up motor per equipment manufacturer's recommendations.
D. Minimum Data to be Recorded:
   1. Motors location / associated equipment / item rotated.
   2. Manufacturer.
   3. Model/Frame.
   4. HP/BHP.
   5. Phase, voltage, amperage; nameplate, actual, no load.
   6. RPM.
   7. Service factor.
   8. Starter size, rating, heater elements.
   9. Sheave Make/Size/Bore.

**END OF SECTION 20 05 13**

**SECTION 20 05 19**
**METERS AND GAUGES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.
B. Thermometers and thermometer wells.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 20 10 05 - Piping.

### 1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2013.
B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers; 2007.
C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2013.
D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.
E. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results, for submittal procedures.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Pressure Gauges (20 05 19 - 002 - A)
   2. Thermometers (20 05 19 - 003 - A)
D. Chart: Provide chart indicating system name, system pressure / temperature operating range, fluid type and instruments scale range.
   1. Pressure Gauges (20 05 19 - 002 - A)
   2. Thermometers (20 05 19 - 003 - A)
E. Start-up Report: Indicate start-up results verifying nominal efficiency, voltages and current.
   1. Refer to section 20 00 00 - Common Work Results.
   2. Fluid Meters (20 05 19 - 004 -A)
F. Project Record Documents: Record actual installed locations of components and tag numbering.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Record Documents (20 00 00 - 005 - A)
G. Operation and Maintenance Data: Include installation instructions and spare parts lists.
   1. Refer to Section 20 00 00 - Closeout Submittals.

2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
3. Operation and Maintenance DVD (20 00 00 - 007 - A)

**PART 2 PRODUCTS**

**2.1 PRESSURE GAUGES**

A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
   1. Case: Steel with brass bourdon tube.
   2. Size: 4-1/2 inch diameter.
   3. Mid-Scale Accuracy: Two percent.
   4. Scale: Psi and KPa.

**2.2 PRESSURE GAUGE TAPPINGS**

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, pipe threads.

**2.3 STEM TYPE THERMOMETERS**

A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

**2.4 THERMOMETER SUPPORTS**

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
B. Thermowells:
   1. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
   2. Material for Use with Copper Tubing: CNR or CUNI.
   3. Material for Use with Steel Piping: CRES.
   4. Type: Stepped shank unless straight or tapered shank is indicated.
   5. Bore: Diameter required to match thermometer bulb or stem.
   6. Insertion Length: Length required to match thermometer bulb or stem.
   7. Lagging Extension: Include on thermowells for insulated piping and tubing.
   8. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
C. Heat-Transfer Medium: Mixture of graphite and glycerin.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.

C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

**3.2 EXAMINATION**

A. Verify that surfaces are suitable for installation.
B. Verify that field measurements are as shown on the drawings.
C. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
D. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
E. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
F. Maintain clearances to combustibles and service clearances.
G. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

A. Install in accordance with the following:
   1. Federal, State and Local Codes.
   2. Manufacturer's recommendations.
B. Pressure Gages:
   1. Provide a pressure gage on the inlet and outlet of the following:
      a. Thermostatic mixing valves
      b. Pressure regulator valves.
      c. Building services at entrance within building.
   2. Provide a quantity of one pressure gauge with adaptor for test ports. Provide test ports at the following locations:
      a. Upstream and downstream of each backflow preventer and calibrated balancing valve.
C. Thermometers:
   1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
   2. Thermowells with heat-transfer medium.
   3. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
   4. Install thermometers in air duct systems on flanges.
   5. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
   6. Provide Thermometers at the following locations:

a. Within the piping connections for the inlet and outlet of thermostatic mixing valves, domestic water recirculation pump, domestic water heaters.

D. Test Plugs:
1. Install at each pressure gauge.
2. Install at each thermometer.
3. Install at each pressure sensor and temperature sensor within a hydronic system.

E. Provide instruments with scale ranges selected according to service with largest appropriate scale.

F. Install instruments in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

**3.4 START-UP**

A. Perform start-up in accordance with 20 00 00 - Common Work Results.
1. Verify system is ready for start-up with visual inspection and sign off from installing personnel.
2. Start-up meter per equipment manufacturer's recommendations.
3. Minimum Data to be recorded.
a. Meters location / associated system.
b. Manufacturer.
c. Model / Size.
d. Start Reading / Units.
e. Confirm same reading within Control System.

**END OF SECTION 20 05 19**

**SECTION 20 05 33**
**HEAT TRACING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Self-regulating parallel resistance electric heating cable.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 20 05 53 - Identification Piping, Duct and Equipment.
C. Section 26 05 83 - Wiring Connections.

### 1.3 REFERENCE STANDARDS

A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2012.
B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

### 1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.
B. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

### 1.5 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Heat Tracing System (20 05 33 - 001 - A)
C. Field Quality Control Submittals: Indicate test reports and inspection reports.
   1. Refer to section 20 00 00 - Common Work Results.
   2. Test Reports (20 05 33 - 002 - A)
D. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.
   1. Refer to Section 20 00 00 - Common Work Results.
   2. Record Documents (20 00 00 - 005 - A)
E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.
   1. Refer to Section 20 00 00 - Common Work Results.
   2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
   3. Operation and Maintenance DVD (20 00 00 - 007 - A)
F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## PART 2 PRODUCTS

## 2.1 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction.
B. Factory Rating and Testing: Comply with IEEE 515.1.
C. Heating Element:
    1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
    2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
    3. Capable of crossing over itself without overheating.
D. Insulated Jacket: Flame retardant polyolefin.
E. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
F. Maximum Power-On Operating Temperature: 150 degrees F.
G. Maximum Power-Off Exposure Temperature: 185 degrees F.

## 2.2 OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.
B. Catalog number, reference number, or model.
C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
D. Agency listing or approval.

## 2.3 CONNECTION KITS

A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.
C. All components UV stabilized.

## 2.4 ACCESSORIES

A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
    1. High temperature, glass filament tape for attachment of heating cable to metal piping.
    2. Cable ties.
    3. Silicone end seals and splice kits.
    4. Installation clips.
    5. Warning labels for attachment to exterior of piping insulation. Refer to Section 20 05 53 - Identification Piping, Duct and Equipment.

## 2.5 CONTROLS

A. Pipe Mounted Thermostats:
    1. Remote bulb unit with adjustable temperature range from 30 to 50 degrees F.
    2. Snap-action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable.

3. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
4. Control Enclosure: Corrosion resistant and waterproof.

## PART 3 EXECUTION

### 3.1 INTERFACE WITH WORK OF OTHER SECTIONS

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

### 3.2 EXAMINATION

A. Verify that piping and equipment are ready to receive work.
B. Verify field measurements are as shown on shop drawings.
C. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
D. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
E. Maintain service clearances.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

A. Install in accordance with:
   1. Federal, State and Local Codes.
   2. Manufacturer's recommendations.
   3. National Electric Code.
   4. IEEE 515.1.
   5. NFPA 70, Article 427.
B. Clean all surfaces prior to installation.
C. Prepare surfaces using the methods recommended by the manufacturer.
D. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.
E. Identification:
   1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft. including cladding over each valve or other equipment that may require maintenance.

### 3.4 START-UP

A. Perform start-up in accordance with Section 20 00 00 - Common Work Results.

1. Heat tracing.

B. Field Testing and Inspections:
   1. Commission system in accordance with installation and operation manual.
   2. Inspect for sources of water entry and proper sealing.
   3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
   4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
   5. Test heating cable integrity with megohmmeter at the following intervals:
      a. Before installing the cable.
      b. After installing the connection kits.
      c. Prior to initial start-up (commissioning).
   6. Measure voltage and current at each unit.
   7. Controls:
      a. Verify control parameters are set to the application requirements.
   8. Submit written test report showing values measured on each test for each cable.

**3.5 TRAINING**

A. Perform training in accordance with Section 20 00 00 - Common Work Results.

**END OF SECTION 20 05 33**

**SECTION 20 05 48**
**SUPPORTS FOR PIPING, DUCTWORK AND EQUIPMENT**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Equipment support bases.
B. Vibration isolators.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Administrative Requirements.
B. Section 09 90 00 - Painting and Coating.
C. Section 20 00 00 - Common Work Results.
D. Section 26 05 83 - Wiring Connections.

### 1.3 REFERENCE STANDARDS

A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2011.
B. ASTM A123- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, American.
C. ASTM B31.9 - Code for pressure piping, ASTM International.
D. ASTM F708- Standard Practice for Design and Installation of Rigid Pipe Hangers, ASTM International.
E. MSS SP-89 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation, Manufacturers Standardization Society, 2009.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data:
    1. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
        a. Equipment Support Bases (20 05 48 - 001 - A)
D. Shop Drawings:
    1. Provide schedule of vibration isolator type with location and load on each.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. General:
    1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.

2. Steel springs to function without undue stress or overloading.
3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
4. Comply with:
    a. ASHRAE Handbook - HVAC Applications.

## 2.2 VIBRATION ISOLATORS

A. Non-Seismic Type:
1. Steel Springs:
    a. Assembly: Freestanding, laterally stable without housing.
    b. Leveling Device: Rigidly connected to equipment or frame.
2. Restrained Steel Springs:
    a. Housing: Rigid blocking during rigging prevents equipment installed and operating height from changing during temporary weight reduction.
    b. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
3. Elastomeric Hangers:
    a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.
    b. Incorporate steel load distribution plate sandwiching elastomeric element to housing.
4. Spring Hanger:
    a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
    b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
5. Combination Elastomeric-Spring Hanger:
    a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
    b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.

## 2.3 PIPE HANGERS & ROOF SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
1. Carbon-Steel Pipe Hangers and Supports:
    a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
    b. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
    c. Nonmetallic Coatings: Plastic coating, jacket, or liner.
    d. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
    e. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
2. Copper Pipe Hangers:
    a. Manufacturers' catalogs indicate that copper pipe hangers are small, typically NPS 4 (DN 100) or smaller, and types available are limited.
    b. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

c. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

3. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
4. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
5. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
   1. Bases: High density polypropylene.
   2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
   3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
   4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
   5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

C. Trapeze Hangers:
   1. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

D. Thermal-Hanger Shield Inserts:
   1. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
   2. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
   3. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
   4. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
   5. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

E. Fastener Systems:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   3. Adhesive Anchoring Systems: Threaded-zinc-coated or Type 316 stainless steel anchor rod, nut, washer, and adhesive capsule, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

F. Pipe Stands:
   1. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

2. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
3. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
4. High-Type, Single-Pipe Stand:
   a. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   b. Base: Plastic.
   c. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
   d. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
5. High-Type, Multiple-Pipe Stand:
   a. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   b. Bases: One or more; plastic.
   c. Vertical Members: Two or more protective-coated-steel channels.
   d. Horizontal Member: Protective-coated-steel channel.
   e. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
6. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Equipment Supports:
1. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
2. Prefabricated Equipment Supports: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with integral metal cant or stepped integral metal cant raised the thickness of roof insulation and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
3. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.
   a. Delete one or more of three subparagraphs below if not applicable. Select width of wood nailer from options in first subparagraph.
   b. Factory-install continuous wood nailers minimum width of 6 inches (290 mm) or to suit supported equipment and minimum 2 inches thick at tops of equipment supports. Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2.
   c. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.
   d. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

e. Equipment support height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer.
f. Fabricate units to minimum height of 24 inches (600 mm), unless otherwise indicated.
g. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.
h. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

## PART 3 EXECUTION

### 3.1 INTERFACE WITH WORK OF OTHER SECTIONS

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

### 3.2 INSTALLATION

A. Install in accordance with the following:
   1. Federal State and Local Codes.
   2. Manufacturer's recommendations.
   3. ASHRAE recommendations.
B. Bases:
   1. Set steel bases for one inch clearance between housekeeping pad and base.
   2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
   3. Adjust equipment level.
C. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
   1. Up to 4 Inches Pipe Size: First three points of support.
   2. 5 to 8 Inches Pipe Size: First four points of support.
   3. 10 inches Pipe Size and Over: First six points of support.
D. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-89.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
b. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

8. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
9. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
    a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
    b. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
10. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
11. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
12. Provide copper plated hangers and supports for copper piping.
13. Prime coat exposed steel hangers and supports. 09 90 00 - Painting and Coating Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
14. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories. Use lock nuts or vibration resistant nuts where potential vibration may cause failure. Install hangers plumb.
15. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
16. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
17. Install lateral bracing with pipe hangers and supports to prevent swaying.
18. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories. Use lock nuts or vibration resistant nuts where potential vibration may cause failure. Install hangers plumb.
19. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
20. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
21. Install lateral bracing with pipe hangers and supports to prevent swaying.

E. Painting:
    1. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
        a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
3. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**3.3 HANGER AND SUPPORT SCHEDULE**

A. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
E. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.
F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
G. Use padded hangers for piping that is subject to scratching.
H. Use thermal-hanger shield inserts for insulated piping and tubing.
I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of uninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
    2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
    3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of uninsulated pipes NPS 3/4 to NPS 36, requiring clamp flexibility.
    4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
    5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of uninsulated, stationary pipes NPS 3/4 to NPS 8.
    6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8.
    7. Adjustable Band Hangers (MSS Type 9): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8.
    8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of uninsulated, stationary pipes NPS 1/2 to NPS 8.
    9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of uninsulated, stationary pipes NPS 3/8 to NPS 8.
    10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of uninsulated, stationary pipes NPS 3/8 to NPS 3.
    11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30. Use only on trapeze hanger systems or on fabricated frames.

12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape. Both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles. Provide with an added malleable-iron heel plate or adapter.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes. Both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): For insulated pipes NPS 4 to NPS 42 (DN 100 to DN 1050) when the temperature of the medium is 60 deg F (15 deg C) or higher. To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
Q. Use powder-actuated fasteners or adhesive anchoring systems or mechanical-expansion anchors instead of building attachments where required in concrete construction.
R. Use pipe stands for piping supports on roof.
S. Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
T. Install roof accessories to fit substrates and to result in watertight performance.
U. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

## 3.4 HANGER AND SUPPORT INSTALLATION

A. Vertical Piping: MSS Type 8 or 42, clamps.
B. Individual, Straight, Horizontal Piping Runs:
    1. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    2. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    3. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
C. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
D. Base of Vertical Piping: MSS Type 52, spring hangers.
E. Support vertical piping and tubing at base and at each floor.
F. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
    2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
    3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

J. Install supports for vertical steel piping every 15 feet.

K. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

L. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

**END OF SECTION 20 05 48**

**SECTION 20 05 53**
**IDENTIFICATION PIPING, DUCT AND EQUIPMENT**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Nameplates.
B. Tags.
C. Pipe and Duct Markers.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Administrative Requirements.
B. Section 20 00 00 - Closeout Submittals.

### 1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.
B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements.
B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
   1. Pipe and duct list (20 05 53 - 002 - A)
C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
   1. Valve chart (20 05 53 - 003 - A)
D. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Name plate (20 05 53 - 001 - A)
   2. Tags (20 05 53 - 001 - A)
   3. Pipe and duct markers (20 05 53 - 001 - A)
E. Project Record Documents: Record actual locations of tagged valves.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Record Documents (20 00 00 - 005 - A)

## PART 2 PRODUCTS

### 2.1 IDENTIFICATION APPLICATIONS

A. Control Panels: Nameplates.
B. Ductwork: Nameplates.
C. Piping: Pipe markers.
D. Small-sized Equipment: Tags.
E. Tanks: Nameplates.
F. Thermostats: Nameplates.

G. Valves: Tags .

**2.2 NAMEPLATES**

A. Letter Height: 1/4 inch.
B. 3"x5" minimum size, Plastic two layers, with engraving depth to the inner layer.
   1. Where piping and duct schedules are indicated on plans, follow system colors.
   2. Where system does not exist, outer layer blue, inner layer white.
C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
D. Label Content: Include caution and warning information, plus emergency notification instructions.

**2.3 TAGS**

A. Metal Tags: Brass with stamped letters; tag size minimum 2" diameter with smooth edges.
B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Submit as electronic PDF with O&M manual.

**2.4 PIPE MARKERS**

A. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
B. Color code as follows:
   1. Where piping and duct schedules are indicated on plans, follow system colors.
   2. Where system does not exist follow ASME A13.1

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Degrease and clean surfaces to receive adhesive for identification materials.
B. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
C. Install tags with corrosion resistant chain.
D. Install plastic pipe markers in accordance with manufacturer's instructions. Locate identification not to exceed 40 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.
E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
F. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. Near major equipment items and other points of origination and termination.

G. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. 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.

H. Install ductwork with plastic nameplates. Identify with air handling equipment identification number and area served. Locate identification at air handling equipment, at each side of penetration of structure or enclosure, at each obstruction and at the following locations:
   1. Near each damper and control device.
   2. Near each branch connection, excluding short takeoffs.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested and equipment.

**END OF SECTION 20 05 53**

**SECTION 20 10 05**
**PIPING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Pipe.
B. Pipe Fittings.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 09 90 00 - Painting and Coating.
C. Section 20 05 48 - Supports for Piping, Ductwork and Equipment.
D. Section 20 05 53 - Identification Piping, Duct and Equipment.
E. Section 31 23 17 - Trenching, Backfilling, and Compacting.

### 1.3 REFERENCE STANDARDS

A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2010.
B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers.
D. ASME B16.9 - Stainless Steel Fittings; The American Society of Mechanical Engineers.
E. ASME B16.11 - Stainless Steel Fittings; The American Society of Mechanical Engineers.
F. ASME B16.12 - Cast Iron Threaded Drainage Fittings; The American Society of Mechanical Engineers.
G. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012.
H. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.
I. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2011.
J. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500; 2011.
K. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2012.
L. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2013.
M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
N. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2013a.
O. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2014.
P. ASTM A182 - Standard for Forged or Rolled Alloy and Stainless Steel.
Q. ASTM A197 - Standard Specification for Cupola Malleable Iron.

R. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.
S. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2013.
T. ASTM A312 - Standard specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel piping.
U. ASTM A358 - Standard specification for Electric Fusion Welded Stainless Steel.
V. ASTM A403 - Standard specification for Stainless Steel Fittings.
W. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2013.
X. ASTM B32 - Standard Specification for Solder Metal; 2008.
Y. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.
Z. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
AA. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.
BB. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2012.
CC. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
DD. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2013.
EE. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
FF. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2012.
GG. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011 and errata.
HH. SAE J514 - Flare Piping Standard.

## 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Submit chart indicating the following: (20 10 05 - 001 - A)
   1. Service.
   2. Application / Fluid type.
   3. Pipe type.
   4. Pipe manufacturer.
   5. Pipe joints.
   6. Fitting manufacturer.
C. Start-up Report: Indicate start-up results.
   1. Refer to Section 20 00 00 - Common Work Results.
   2. System pressure tests (20 10 05 - 002 -A)

## 1.5 QUALITY ASSURANCE

A. Welder Qualifications: Certified in accordance with ASME (BPV IX).

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

**1.6 FIELD CONDITIONS**

A. Do not install underground piping when bedding is wet or frozen. Refer to Section 31 23 17 - Trenching, Backfilling, and Compacting.

**PART 2 PRODUCTS**

**2.1 DIELECTRIC FITTINGS**

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Standard: ASSE 1079.
   2. Revise pressure rating and temperature in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.
   3. Pressure Rating: 150 psig.
   4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:
   1. Standard: IAPMO PS 66.
   2. Electroplated steel nipple complying with ASTM F 1545.
   3. Revise pressure rating and temperature in "Pressure Rating and Temperature" Subparagraph below to suit Project, or insert other options for specific applications.
   4. Pressure Rating and Temperature: 300 psig at 225 deg F.
   5. End Connections: Male threaded or grooved.
   6. Lining: Inert and noncorrosive, propylene.

D. Unshielded, Nonpressure Transition Couplings:
   1. Standard: ASTM C 1173.
   2. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   3. Sleeve Materials:
      a. For Cast-Iron Storm, soil Pipes: ASTM C 564, rubber.
      b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

E. Shielded, Nonpressure Transition Couplings:
   1. Standard: ASTM C 1460.
   2. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

**2.2 PIPE AND PIPE FITTINGS**

A. Pipe shall conform to the materials specified herein, and shall be installed for piping systems as scheduled on drawing.

**2.3 COPPER PIPE - TYPE L**

A. Design Pressure: 150 psig.
B. Maximum Design Temperature: 200 degrees F.
C. Sizes 2 Inches and Smaller:
    1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
    2. Joints: Solder type with 95-5 solder.
    3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
D. Sizes 2 1/2 Inches and Larger:
    1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
    2. Joints: Flanged and solder type with 95-5 solder.
    3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
    4. Flanges: 150 lb. class cast bronze, ASME B16.24.
E. All piping installed in medical gas piping systems shall be oxygen clean, Type L copper or ACR medical gas piping with brazed joints, in accordance with NFPA 99.

**2.4 COPPER TUBING - TYPE L**

A. Design Pressure: 240 psig.
B. Maximum Design Temperature: 125 degrees F.
C. Sizes 4 Inches and Smaller:
    1. Tubing: Type L hard drawn seamless copper tube, ASTM B280 (ACR).
    2. Joints: Brazed, AWS A5.8 B Cup silver/phosphorus/copper alloy.
    3. Fittings: Wrought copper solder joint, ASME B16.22.

**2.5 COPPER PIPE - TYPE DWV**

A. Design Pressure: Gravity.
B. Maximum Design Temperature: 180 degrees F.
C. Sizes 1-1/4 Inches through 4 Inches:
    1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.
    2. Joints: Solder. ASTM B32, Grade 50B.
    3. Fittings: Cast bronze solder joint drainage type, ASME B16.23 or wrought copper solder joint drainage type, ASME B16.29.
D. DWV copper shall not be installed for branch drainage piping that receives waste from waterless urinals.

**2.6 GALVANIZED STEEL PIPE - SCHEDULE 40**

A. Design Pressure: 125 psig.
B. Sizes 4 Inches and Smaller:
    1. Pipe: Schedule 40 galvanized steel, threaded and coupled, ASTM A53.
    2. Joints: Threaded or mechanically coupled grooved joint.
    3. Fittings: Galvanized cast iron threaded drainage type, ASME B16.12 or Schedule 40 galvanized steel mechanically coupled grooved joint.
C. Sizes 5 Inches and Larger:
    1. Pipe: Schedule 40 galvanized steel, threaded and coupled or beveled as required.
    2. Joints: Horizontal; threaded or mechanically coupled grooved joint. Vertical; butt welded.
    3. Fittings: Schedule 40 seamless steel, threaded or mechanically coupled grooved joint.

4. Fittings: 150 lb (S) 300 lb (WOG) galvanized malleable iron, banded, ASTM A197, ASME B16.3 or flanged 125 lb (S) 175 lb (WOG) galvanized cast iron, ASTM A126, ASME B16.1.

D. Special Installation Requirements:
1. Where galvanizing has been burned off from welding, clean surfaces and paint with one coat of rust inhibiting metal primer. When dry paint with one coat of oil base aluminum enamel.
2. Where standard weight seamless steel butt weld fittings are used, clean surfaces and paint with one coat of rust inhibiting metal primer. When dry paint with one coat of oil base aluminum enamel.
3. All pipe with mechanically coupled grooved joints shall maintain a maximum 1/4 inch per foot slope.

## 2.7 CAST IRON PIPE - SERVICE WEIGHT

A. Design Pressure: Gravity.
B. Maximum Design Temperature: 180 degrees F.
C. All Pipe Sizes:
1. Pipe & Fittings: Service weight cast iron soil pipe, tar coated inside and outside, ASTM A74, A888.
2. Joints: Below ground; push on. Above ground; no hub.
3. Adapters: Transitions from cast iron soil pipe to another pipe material shall be made with Fernco Joint Sealer Company PVC Donuts adapters, or approved equal.

## 2.8 STAINLESS STEEL PIPE - SCHEDULE 40

A. Comply with one of the following:
1. ASTM A312/A312M, Type TP304L, seamless only, Schedule 40S for pipe less than 8 inch in diameter or Schedule 10S for pipe 8 inch and larger.
2. ASTM A358/A358M, Grade 304L, Class 1 or 3, longitudinally welded.
a. 100 percent of factory longitudinal welds, radiographically inspected in accordance with ASME BPV VIII, 1.
b. 0.25 inch minimum wall thickness for pipe 12 inch and smaller and 0.312 inch for pipe greater than 12 inch.

B. Fittings 2 inch and Smaller:
1. Stainless steel, socket weld type.
2. Comply with ASME B16.11 and ASTM A182/A182M.

C. Fittings 2-1/2 inch and Larger:
1. Stainless steel, butt weld type.
2. Comply with one of the Following:
a. ASTM A403/A403M, Class WP-S, Grade WP 304L, seamless only and ASME B16.9 of the same thickness as the adjoining pipe.
b. ASTM A403/A403M, Class WP-XX, Grade WP 304L, wall thickness as indicated.
1) Prohibit forming with fusion without addition of filler material.

## 2.9 STAINLESS STEEL TUBING

A. Control Piping:
1. Seamless, fully annealed, stainless steel tubing.
2. Comply with ASTM A269, Grade TP316L, with hardness number not to exceed 80 HRM.

3. Fittings:
    a. Flareless, Type 316 stainless steel.
    b. Comply with SAE J514.

**2.10 PVC PIPE - SCHEDULE 40**

A. Design Pressure: Gravity.
B. Maximum Design Temperature: 150 degrees F. at continuous flow.
C. All Pipe Sizes:
    1. Schedule 40, polyvinyl chloride (PVC), ASTM D2665 with NSF seal.
    2. Fittings: Schedule 40, polyvinyl chloride, DWV pattern, ASTM D2665 with NSF seal.
D. Sizes: 2 Inches and Smaller:
    1. Joints: Socket or factory threaded solvent cement ASTM D2564.
E. Sizes: 2-1/2 Inches or Larger:
    1. Joints: Socket or flanged solvent cement ASTM D2564.

**2.11 PVC PIPE - SCHEDULE 80**

A. Design Pressure: 125 psig.
B. Maximum Design Temperature: 80 degrees F.
C. Sizes 8 Inches and Smaller:
    1. Pipe: Schedule 80, Class 1120, type 1, normal impact, polyvinyl chloride (PVC) ASTM D1785 with NSF seal.
    2. Fittings: Schedule 80 polyvinylchloride ASTM D2467 with NSF seal. Socket, factory threaded or flanged solvent cement.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.

**3.2 INSTALLATION**

A. Perform work in accordance with the following:
    1. Federal, State and Local Codes.
    2. Manufacturer recommendations.
    3. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
    4. Install copper tubing according to CDA's "Copper Tube Handbook."
        a. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.
    5. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
        a. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.
        b. Install buried piping inside building between wall and floor penetrations and connection to piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
        c. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.

6. Install cast-iron Storm, soil piping according to CISPI's "Cast Iron Storm, soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Storm, soil Pipe and Fittings."
    a. Install encasement on underground piping according to ASTM A674 or AWWA C105/A21.5.

B. Install components having pressure rating equal to or greater than system operating pressure.

C. Piping Installation:
1. Contractor shall carefully follow the Drawings in laying out and installing his work and he shall not deviate therefrom, except for structural or interior finish interferences, and then only upon Engineer’s approval.
2. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
3. Install piping free of sags and bends.
4. All pipe shall be cut to exact measurement, and installed without springing or forcing. 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.
5. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
6. Run pipe lines straight and true, parallel to building lines with a minimum use of offsets and couplings. Use full and double lengths of pipe wherever possible.
7. Changes in direction shall be made only with pipe bends or fittings. Changes in size shall be made with fittings only. All fittings shall be of the long radius type, unless otherwise specified.
8. Slope piping and arrange systems to drain at low points.
9. 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.
10. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
11. Install fittings for changes in direction and branch connections.
12. Install piping to permit valve servicing.
13. Install piping to allow application of insulation plus 1-inch (25mm) clearance around insulation.

D. Pipe Fitting Installation:
1. Unless otherwise indicated, branch take offs shall be from top of mains or headers at either a 45 degree or 90 degree angle from the horizontal plane for air and gas lines, and from top, bottom or side for liquids.
2. Install couplings according to manufacturer's printed instructions.
3. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
4. Pipe joints connecting dissimilar metals shall be insulating, dielectric connections. Copper tubing shall be protected from electrolysis at contact points with ferrous metals, including temporary methods of support, by use of insulating, non-conductive spacers such as rubber, fiberglass or an approved equal. Pipe hangers for bare copper tubing shall be copper plated.
5. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
6. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

7. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
8. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.
9. Unless otherwise indicated, install all piping to pumps and other equipment at line size with reduction in size being made only at inlet to pump or equipment connection.
10. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Gravity Drainage System Installation:
1. Make changes in direction for gravity drainage systems, Storm drainage, sanitary, soil and waste 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 two 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 change direction of flow more than 90 degrees.
2. Changes in direction on drainage pipe systems shall be made with wye fittings, combination wye and eighth bends, or one eighth bends. Offset in soil or waste pipes will not be permitted where avoidable. Offsets shall be made with 45 degree bends or similar fittings.
3. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
4. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.

G. Install storm drainage, soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

H. All pipe and fittings shall be carefully inspected for defects in workmanship prior to installation. Any item found unsuitable, cracked, or otherwise defective shall be rejected and removed from the jobsite. All pipe and fittings shall have factory applied markings, stampings, or nameplates with sufficient data for identification to determine their conformance with specified requirements.

I. Plastic piping shall be installed in strict accordance with pipe manufacturer's recommendations and in accordance with the recommendations of the referenced standards. Protect piping from damage by adjacent sharp surfaces with rubber or plastic grommets or sleeves.

J. Plastic piping installed underground shall be encased in sand for a minimum of 6" sand.

K. During construction all openings in piping shall be kept closed except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.

L. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00 - Painting.

M. Underground pressure piping shall be provided with concrete anchors and thrust blocks at ends of runs and changes in direction.

N. Pipe Joints:

1. No-hub Coupling: Heavy duty coupling.
    a. AISI 304 stainless steel bi-directional corrugated shield.
    b. AISI 304 stainless steel clamps and screw housing.
    c. Gasket shall conform to ASTM C564.
2. Mechanically Coupled Grooved Joints: Mechanical coupling connections shall consist of malleable iron housing clamps, steel bolts, and nuts, and sealing gasket designed, such that internal pressure tends to increase the tightness of the seal.
    a. The entire installation, including pipe grooving, shall be accomplished in accordance with manufacturer's published instructions.
    b. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
3. Push On Joints, Pressure Pipe: Joints shall be single gasket type. The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to maximum of 5 degrees. Plain spigot ends shall be suitably beveled to permit easy entry into bell, centering in gasket and compression of gasket.
    a. The joint shall be liquidtight under all pressure ranges from vacuum up to 350 psig.
    b. Lubricant:
        1) Provide a thin coat on each spigot end.
        2) Non toxic and shall impart no taste or odor to conveyed liquid.
        3) Shall have no deleterious effect on the rubber gasket.
        4) The lubricant shall be of such consistency, that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.
    c. Place hub ends of piping upstream.
    d. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
    e. Maintain swab in piping and pull past each joint as completed.
4. Push On Joints, Soil Pipe: Joint shall be one piece double seal compression type gasket made specifically for joining cast iron soil pipe.
    a. The gasket shall be neoprene material, permitting joint to flex as much as 5 degrees without loss of seal.
    b. Gasket shall be extra heavy conforming to ASTM C564 and shall be shielded with a stainless steel shroud covering the entire length of the gasket.
    c. 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.
5. Solder Joints: 95 percent tin and 5 percent antimony (95-5) solder conforming to ASTM B32 Solder Metal, Grade 95TA.
    a. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside.
    b. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to soldering.

c. Apply non-acid type flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder will flow to all mated surfaces.
d. Wipe excess solder, leaving a uniform fillet around cup of fitting.

6. Brazed Joints: Make up joints with silver alloy brazing filler metal.
   a. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside.
   b. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing.
   c. Apply non corrosive flux of the type recommended by filler alloy manufacturer evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly to proper brazing temperatures using oxygen acetylene torch with tip size as recommended by fitting manufacturer.
   d. Wipe and brush joint clean after allow has set.
7. Welded Joints: Shall be in accordance with Section IX, ASME Boiler & Pressure Vessel Code, unless mandatory local codes take precedence.
   a. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
8. Threaded Joints: Pipe screw threads shall conform to National Standard Piping Threads. Ream pipe ends and remove all burrs and chips formed in cutting and threading. Protect plated pipe and brass valve bodies from wrench marks when making up joint.
9. Flanged Joints: Bolting for services up to 500 degrees Fahrenheit, Grade B with square head bolts and heavy hexagonal nuts.
   a. Steel pipe flanges shall conform to ASME B16.5, Steel Pipe Flanges and Flanged Fittings.
   b. Cast iron pipe flanges shall conform to ASME B16.1, Cast Iron Flanges and Flanged Fittings.
   c. Steel flanges shall be raised face except when bolted to flat cast iron flange.
   d. Gaskets for flat face flanges shall form to requirements for Group I Gaskets in ASME B16.5. Unless otherwise specified, gaskets shall be 3/32 inch thick.
   e. 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.
10. Solvent Cement Joints: Socket joints in PVC, ABS, etc., pipe shall be made by using a manufacturer's recommended solvent cement suitable for respective pipe (CPVC, PVC, ABS, Schedule 40, Schedule 80) and conforming to ASTM D2564.
    a. Follow manufacturer's instructions for handling and cementing procedures.
    b. Wipe off excess cement fillet around socket.
    c. Do not move pipe while cement is setting.
11. Factory Threaded Solvent Cement Joints: Factory threaded solvent cement joints for plastic pressure piping systems shall be made in accordance with manufacturer's recommendations. The threads should be lubricated with a non hardening pipe dope or wrapped with Teflon tape.

O. Specialty Pipe Fitting Installation:
1. Transition Couplings:
   a. Install transition couplings at joints of piping with small differences in OD's.
   b. In Drainage Piping: Unshielded, non pressure transition couplings.
   c. In Aboveground Force Main Piping: Fitting-type transition couplings.

d. In Underground Force Main Piping:
   1) NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   2) NPS 2 and Larger: Pressure transition couplings.

2. Dielectric Fittings:
   a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
   b. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
   c. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges.

**3.3 TESTING**

A. Test piping according to system requirements. Refer to 20 00 00 - Common Work Results.

B. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

**END OF SECTION 20 10 05**

**SECTION 20 10 07**
**VALVES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. General Valves. For other systems refer to individual Division 21, 22, and 23 Sections.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 20 05 53 - Identification Piping, Duct and Equipment.
C. Section 20 10 05 - Piping.
D. Division 21.
E. Division 22.
F. Division 23.

### 1.3 REFERENCE STANDARDS

A. ASME B1.20.1- This Standard covers dimensions and gaging of pipe threads.
B. ASME B16.1- Standards covers pipes and fittings in cast iron, cast bronze, wrought copper.
C. ASME B16.8 - Standards covers pipe flanges.
D. ASME B16.10 for ferrous valve dimensions and design criteria.
E. ASME B16.34 for ferrous valve dimensions and design criteria.
F. ASME B31.1 for power piping valves.
G. ASME B31.9 for building services piping valves.
H. AWWA C606 - American Water Works Association.
I. MSS SP-67 Butterfly Valves.
J. MSS SP-72 Ball valves with flanged or butt - welding ends for general service.
K. MSS-SP-80 Bronze Gate, globe angle and check valves.
L. MSS-SP-110 Ball Valves Threaded Socket-Welding Solder Joint Grooved and Flared Ends.
M. NSF - National Sanitation Foundation.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements, for submittal procedures.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Valves (20 10 07 - 001 - A)
   2. Check valves (20 10 07 - 002 - A)
   3. Hose end valves (20 10 07 - 003 - A)
D. Submit a Certificate of Compliance, Section 00 62 33.14, together with supporting data, from the materials supplier(s) attesting that valves, accessories, and specialties meet or exceed specification requirements and are designed for the system specified.

1. Valves (20 10 07 - 001 - A)
2. Check valves (20 10 07 - 002 - A)
3. Hose end valves (20 10 07 - 003 - A)

E. Project Record Documents: Record actual locations of valves.
1. Refer to Section 20 00 00 - Closeout Submittals.
2. Record Documents (20 00 00 - 005 - A)

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Provide Owner with one operating wrench for every ten (10) valves of each type (but not less than 2 wrenches) not equipped with hand wheels or levers.

**1.5 QUALITY ASSURANCE**

A. Valves: Manufacturer's name and pressure rating marked on valve body.

**1.6 DELIVERY, STORAGE, AND HANDLING**

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
B. Provide temporary protective coating on cast iron and steel valves.

**PART 2 PRODUCTS**

**2.1 VALVES**

A. Furnish and install valves as specified herein and as scheduled in Part 3 – Execution, of this Section. Insofar as possible all valves shall be of a single manufacturer.
B. Packings, gaskets, discs, seats, diaphragms, lubricants, etc., shall conform to recommendations of the valve manufacturer for the intended service.
C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
D. Valve Sizes: Same as upstream piping unless otherwise indicated.
E. Valve Actuator Types:
1. Hand Wheel: For valves other than quarter-turn types.
2. Hand Lever: For quarter-turn valves NPS 6 and smaller.
3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
G. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Valve solder-joint connections are common in smaller sizes of plumbing piping. Soldering and brazing methods used to achieve required pressure-temperature ratings may damage internal valve parts. Special installation requirements for soldered valves may make threaded valves more cost-effective.
H. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves and below 421 deg F (216 deg C) for ball valves.

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

I. If space permits, install valves with stems horizontal or extending vertically upward unless specifically shown otherwise. Valves shall be installed in accessible locations for operation as well as for removal, repair, or replacement.

## 2.2 BALL VALVES

A. Ball Valve 1 (BA-1):
1. Size: 2" and smaller.
2. Pressure (psig): 150S, 400WOG.
3. Description: NSF approved for potable water (Domestic water systems); bronze, 3 piece breakdown style body; stainless steel ball; teflon seats; full port design.
4. Manufacturer: Anvil International, Apollo, Nibco, or equal.

B. Ball Valve 2 (BA-2):
1. Size: 2" and smaller.
2. Pressure (psig): 150S, 400WOG.
3. Description: NSF/AWWA approved for potable water (Domestic water systems); chlorinated polyvinyl chloride (CPVC) body; ball Teflon seats, O-ring seals; teflon seats; true union; full port design.
4. Manufacturer: Nibco, R.G. Sloane, or equal.

C. Ball Valve 3 (BA-3):
1. Size: 2" through 8”
2. Pressure (psig): 200WC, 200 degrees F.
3. Description: NSF approved for potable water (domestic water systems); epoxy coated A126 Class B iron body; teflon-fused solid ball; full port; 100 percent lead free.
4. Manufacturer: American Valve, or equal.

## 2.3 CHECK VALVES

A. Check Valve 2 (CK-2):
1. Size: 2" and smaller.
2. Pressure (psig): 125S, 200WOG.
3. Description: Bronze body; renewable bronze disc swing type.
4. Manufacturer: Crane, Nibco, Hammond, Anvil International, Milwaukee, or equal.

B. Check Valve 5 (CK-5):
1. Size: 2-1/2" and smaller.
2. Pressure (psig): 125S.
3. Description: Iron body; Lift type, nickel allow seat and disc.
4. Manufacturer: Crane or equal.

## 2.4 HOSE END VALVES:

A. Hose Valve:
1. Size: 3/4".
2. Description: Bronze Body; two piece; full port; hose connection with cap and bead chain.
3. Manufacturer: Apollo, Nibco, or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Perform work in accordance with the following:
   1. Federal, State and Local Codes.
   2. Manufacturer's Requirements.

B. All valves shall be carefully inspected for defects in workmanship prior to installation. Any item found unsuitable, cracked, or otherwise defective shall be rejected and removed from the job site. All valves shall have factory applied markings, stampings, or nameplates with sufficient data for identification to determine their conformance with specified requirements.

C. Provide flanges or unions at all final connections to valves to facilitate dismantling.

D. Unless otherwise indicated, install all shutoff valves to fixture or equipment at line size with reduction in size being made only at inlet to equipment or fixture.

E. Furnish and install valve tag per section 20 05 53 - Identification Piping, Duct and Equipment.

F. Furnish and install access doors for concealed valves per section 20 00 00 - Common Work Results.

G. Furnish and install valves rated and compatible with system type and pipe type per section 20 10 05 - Piping.

### 3.2 SCHEDULE

A. Valves shall be installed in accordance with the following valve schedule:
   1. Valve Service: Shut-Off:
      a. Domestic Water, Copper: BA-1, BA-3, GA-2, or BF-4
      b. Domestic Water, PVC: BA-2
   2. Valve Service: Check:
      a. Domestic Water, Copper: CK-2 or CK-3
      b. Domestic Water, PVC: CK-2
   3. Valve Service: Hose End:
      a. Strainer blow down.
      b. System drain valve.

**END OF SECTION 20 10 07**

**SECTION 20 10 16**
**INSULATION**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Insulation.
B. Covering.

### 1.2 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating.
B. Section 20 00 00 - Common Work Results.
C. Section 20 05 53 - Identification Piping, Duct and Equipment.
D. Section 20 10 05 - Piping.

### 1.3 REFERENCE STANDARDS

A. ASHRAE 90.1- Energy Standard for Buildings except Low-Rise Residential Buildings.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2010.
E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2013.
F. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
G. ASTM C795- Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel, ASTM International.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
J. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
    1. Furnish detail cross section of insulation assembly. Indicate pipe type, fluid, vapor barriers, insulation and cover. Indicate two sections for each system, one section at typical section, one section at hanger or support location.
    2. Furnish schedule indicating insulation assembly for system type, insulation thickness, thermal characteristics and overall assembly dimensions. Manufacturer shall validate and provide

documentation indicated that schedule thickness meets ASHRAE 90.1 insulation requirements.

3. Submit products grouped by system type. (20 10 16 - 001 - A)

D. Submit a Certificate of Compliance, Section 00 62 33.14, together with supporting data, from the materials supplier(s) attesting that valves, accessories, and specialties meet or exceed specification requirements and are designed for the system specified.

1. Submit products grouped by System Type (20 10 16 - 001 - A)

E. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

**1.5 QUALITY ASSURANCE**

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

**PART 2 PRODUCTS**

**2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with NFPA 255.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C795.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

**2.2 ELASTOMERIC**

A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 2, in sheet form.

1. Minimum Service Temperature: -70 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent.
4. Maximum Density: 8.0 lb/cu ft.

C. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.

1. Minimum Service Temperature: -40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

D. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

E. Manufacturer:

1. Aeroflex USA, Inc.
2. Armacell LLC.

3. K-Flex USA LLC.
4. Or equal.

**2.3 JACKETS**

A. PVC Plastic:
   1. Jacket: Sheet material in color as indicated.
      a. Minimum Service Temperature: -40 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil.
      e. Connections: Brush on welding adhesive.
   2. Manufacturers:
      a. Johns Manville Corporation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: Smooth.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
   1. Thickness: 0.010 inch.
   2. Finish: Smooth.
   3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify that equipment and system has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

**3.2 INSTALLATION**

A. Install in accordance with the following:
   1. Manufacturer's instructions.
   2. Local codes.
   3. Contract documents.
   4. ASHRAE 90.1.

B. Items Not Insulated:
   1. Fibrous-glass ducts.
   2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
   3. Factory-insulated equipment.
   4. Factory-insulated flexible ducts.

5. Factory-insulated plenums and casings.
6. Flexible connectors.
7. Vibration-control devices.
8. Factory-insulated access panels and doors.

C. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
D. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
E. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
F. Locate insulation and cover seams in least visible locations. Locate seams on bottom of piping, duct and equipment.
G. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
H. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
I. Fiber glass insulated products containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied.
J. Inserts and Shields:
   1. Application: Equipment 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between hangers and inserts.
   3. Insert Location: Between support shield and equipment and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
K. Finish insulation at supports, protrusions, and interruptions.
L. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

**3.3 SCHEDULE**

A. Acceptable insulation materials and thicknesses are identified for each system. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. Refer to piping and duct schedule on drawings.

**END OF SECTION 20 10 16**

**SECTION 22 10 06**
**PLUMBING PIPING SPECIALTIES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Floor Drains.
B. Cleanouts.
C. Miscellaneous Sanitary Drainage Piping Specialties.
D. Hose Bibbs.
E. Wall Hydrants.
F. Backflow Preventers.
G. Water Hammer Arrestors.
H. Mixing Valves.
I. Strainers.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Administrative Requirements.
B. Section 20 00 00 - Closeout Submittals.
C. Section 03 30 00 - Cast-In-Place Concrete.
D. Section 20 00 00 - Common Work Results.
E. Section 20 10 07 - Valves.
F. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

### 1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ASME A112.6.3 - Floor and Trench Drains 2019.
C. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance 2011 (Reaffirmed 2016).
D. NSF 61 - Drinking Water System Components - Health Effects 2022, with Errata.
E. NSF 372 - Drinking Water System Components - Lead Content 2022.
F. PDI-WH 201 - Water Hammer Arresters 2017.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements, for submittal procedures.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
    1. Provide component sizes, rough-in requirements, service sizes, and finishes. Indicate dimensions, weights, and placement of openings and holes.
    2. Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

3. Floor Drains (22 10 06 - 002 - A)
4. Cleanouts (22 10 06 - 002 - A)
5. Hose Bibbs (22 10 06 - 003 - A)
6. Hydrants (22 10 06 - 003 - A)
7. Backflow Preventers (22 10 06 - 004 - A)
8. Water Hammer Arrestors (22 10 06 - 005 - A)
9. Mixing Valves (22 10 06 - 007 - A)
10. Strainers (22 10 06 - 009 - A)

D. Start-up Report: Indicate start-up results.
1. Refer to section 20 00 00 - Common Work Results.
2. Backflow Preventers (22 10 06 - 011 - A)
3. Mixing Valves (22 10 06 - 013 - A)

E. Test Report: Indicate procedures and results.
1. Refer to section 20 00 00 - Common Work Results.
2. Backflow Preventers (22 10 06 - 011 - A)

F. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.
1. Refer to Section 20 00 00 - Closeout Submittals.
2. Record Documents (20 00 00 - 005 - A)

G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
1. Refer to Section 20 00 00 - Closeout Submittals.
2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
3. Operation and Maintenance DVD (20 00 00 - 007 - A)

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. 2 additional full grate covers for each type of floor drain.
2. 2 additional covers for each type of clean out and 1 clean out wrench for each type.
3. 2 additional handles / keys for each type of hose bibb.
4. 2 additional handles / keys for each type of wall hydrant.

I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
2. Floor Drains.
3. Cleanouts.
4. Hose Bibbs.
5. Hydrants.
6. Backflow Preventers.
7. Water Hammer Arrestors.
8. Mixing Valves.
9. Strainers.

## 1.5 WARRANTY

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide 3 year warranty, including parts, materials and labor for defective parts, for the following:

1. Include in Closeout Submittals Book.
2. Floor Drains.
3. Cleanouts.
4. Hose Bibbs.
5. Hydrants.
6. Backflow Preventers.
7. Water Hammer Arrestors.
8. Mixing Valves.
9. Strainers.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

### 2.2 FLOOR DRAINS

A. Load Classifications:
   1. All items and covers shall have a live load as follows:
   2. Light Duty: 1,500 - 2,000 pounds.
   3. Medium Duty: 2,001 - 4,999 pounds.
   4. Heavy Duty: 5,000 - 7,499 pounds.
   5. Extra Heavy Duty: 8,000 - 10,000 pounds.

B. Floor Drain, FD1.#:
   1. ASME A112.6.3; Heavy Duty, Stainless Steel, and square, adjustable stainless steel strainer with sediment bucket .
   2. Vandal proof screws.
   3. Elastomeric PVC material molded to fit floor drain. Closes under no flow condition to prevent sewer gas from escaping.
      a. Manufacturer: Pro-Set Trap Guard.
   4. Deep Seal Cast Iron Trap:
      a. Manufacturer: Charlotte pipe.
   5. Manufacturer:
      a. Jay R. Smith Manufacturing Company, Series 3006.

### 2.3 CLEANOUTS

A. Load Classifications:
   1. All items and covers shall have a live load as follows:
      a. Light Duty: 1,500 - 2,000 pounds.
      b. Medium Duty: 2,001 - 4,999 pounds.
      c. Heavy Duty: 5,000 - 7,499 pounds.
      d. Extra Heavy Duty: 8,000 - 10,000 pounds.

B. Cleanouts at Exterior Surfaced Areas, CO1.#:
   1. Heavy Duty, round cast nickel bronze access frame and non-skid cover.

2. Plug to accept plug closure handle.
3. Cast iron body design to be set within concrete; blacktop, rated for medium vehicle traffic.
4. Cast iron body design to be set within grade rated for light traffic, mowing tractors.
5. Vandal proof top and bronze plug.
6. Manufacturer:
    a. Jay R. Smith Manufacturing Company, Series 4318.

C. General Duty Cleanouts at Interior Finished Floor Areas, CO2.#:
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed "CO" scored cover.
2. Plug to accept plug closure handle.
3. Manufacturer:
    a. Jay R. Smith Manufacturing Company, Series 4120.

**2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES**

A. Open Drains:
1. Description: Shop or field fabricate from ASTM A74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of 2 size larger than connection size.

B. Deep Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:
1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:
   1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
   2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals:
   1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
   2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints:
   1. Standard: ASME A112.21.2M.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

## 2.5 HOSE BIBBS

A. Interior Hose Bibbs, HB-1:
   1. Stainless steel recessed box with hinged locking cover that opens full 180°, brass body with handwheel, hose thread spout, integral vacuum breaker in conformance with ASSE 1011.
      a. Removable handwheel.
      b. Manufacturer:
         1) Jay R. Smith Manufacturing Company, Series 5573.

## 2.6 WALL HYDRANTS

A. Wall Hydrants, WH-1:
   1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.
   2. Stainless steel, recessed box with locking cover. Provide "WATER" on cover, adjustable wall clamp.
   3. Manufacturer:
      a. Jay R. Smith Manufacturing Company, Series 5509QT.

## 2.7 FLEXIBLE CONNECTORS

A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## 2.8 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers, RPZ:
   1. ASSE 1013; Stainless steel body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four

test cocks.
2. Air Gap Fitting.
3. Manufacturer:
   a. Watts Regulator Company, Series 909, up to 2inch.

B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. ASSE 1001. Bronze cast body. Rough bronze finish.

C. Hose-connection vacuum breakers in first paragraph below are for low hazard and are unsuitable for continuous pressure. Outlet size is garden-hose thread.
1. Hose-Connection Vacuum Breakers Insert drawing designation if any:
   a. ASSE 1011. Bronze body, nonremovable, with manual drain.
   b. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
   c. Finish: Chrome or nickel plated.

**2.9 WATER HAMMER ARRESTORS**

A. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.
2. Manufacturer:
   a. Watts regulator Company, Series LF15M2.

**2.10 MIXING VALVES**

A. Point-of-Use Thermostatic Mixing Valves: TMV-1
1. Valve: Cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
2. Lead Free with adjustment locking screw, integral checks and screens.
3. 0.5 GPM minimum Flow, 4.0 GPM flow with 5 PSI pressure loss. 120 degrees fahrenheit inlet on hot, 110 degree Fahrenheit outlet.
4. Manufacturer:
   a. Powers Valve Company, Series LFLM495.

**2.11 STRAINERS**

A. Size 4 inch and Under:
1. Lead free bronze body for 175 psi CWP, wye pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, wye pattern with 1/32 inch stainless steel perforated screen.
3. Manufacturer:
   a. Watts LF777S.

B. Size 2 inch to 12 Inch:
1. Class 125 Flanged connection, cast iron body with FDA epoxy coating, wye pattern with 1/16 inch stainless steel perforated screen.
2. Manufacturer:
   a. Watts 77DI-FDA.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 28 31 00 - Fire Detection and Alarm.
D. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.
E. Confirm rough-in location and slope of floor assembly towards drain.
F. Confirm rough-in locations and requirements before rough-in installation.

**3.2 EXAMINATION**

A. Verify that piping and equipment are ready to receive work.
B. Verify field measurements are as shown on shop drawings.
C. Electrical:
    1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for electrical connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
D. Controls:
    1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for control connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
E. Maintain service clearances.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

A. Install in accordance with the following:
    1. Federal, State and Local Codes.
    2. Manufacturer's Instructions.
    3. 36 CFR 1191.
    4. NSF 61.
B. Floor Drains:
    1. Install floor drains within flooring system.
    2. Coordinate floor drain direction with flooring pattern.
    3. Align drains with grout lines and tile sides.
    4. Align drains with walls and partitions.
    5. Position floor drains for easy access and maintenance.
    6. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
        a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
        b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

7. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
8. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

C. Clean outs:
1. Extend cleanouts to finished grade, finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
a. Encase exterior cleanouts in concrete flush with grade.
b. Install floor cleanouts at elevation to accommodate finished floor.
2. Furnish and install cleanouts every 50 linear feet in drainage piping.
3. Furnish and install cleanouts at every 90 degree change in drainage piping.
4. Furnish and install cleanouts at the base of every stack in drainage piping.
5. Furnish and install cleanouts 4'-0" from the edge of the building at the exterior of the building for each drainage piping.
6. Exterior Cleanouts: CO1.X
7. Interior Cleanout: CO2.X, Located in the following areas:
a. General Areas.

D. Miscellaneous Sanitary Drainage Specialties:
1. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
2. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
3. Assemble open drain fittings and install with top of hub 2 inches above floor.
4. Install deep-seal traps on floor drains and other waste outlets, if indicated.
5. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
6. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
7. Install vent caps on each vent pipe passing through roof.
8. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
9. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

E. Hose Bibb:
1. Mount hose bibb a minimum of 30 inches above finished floor. Unless mounted below a lavatory, then mount hose bibb 24 inches above finished floor.
2. Secure hose bibb to wall using metal fasteners.
3. Seal around wall penetration and hose bibb.

F. Wall Hydrants:
1. Install hydrants within wall assembly.
2. Coordinate with wall for masonry coursing and place wall hydrants within coursing.

G. Backflow Preventers:

1. Extend vents and drain connection to floor drain within space.
2. Furnish test report for backflow preventer.
3. Perform start-up in accordance with Section 20 00 00 - Common Work Results.

H. Water Hammer Arrestors:
1. Install water hammers on cold and hot water piping serving fixtures or equipment with solenoid actuated valves.
2. Install per PDI-WH 201.
3. Provide access panel to water hammer arrestors per Section 20 00 00 - Common Work Results.

I. Thermostatic Mixing Valves:
1. Set valve to temperature.
2. Provide IT data drop next to valve location. Furnish and install conduit, box, wiring and termination devices from box to network server.
3. Coordinate power and building control connection with other trades.
4. Perform start-up in accordance with Section 20 00 00 - Common Work Results.

J. Strainers:
1. Install hose end valve with cap and chain on blow down connection. Refer to section 20 10 07 - Valves.
2. Flush strainers and check screens after system has been filled and operation for 5 days.

## 3.4 TRAINING

A. Perform training in accordance with Section 20 00 00 - Common Work Results.

## 3.5 START-UP

A. Perform start-up in accordance with Section 20 00 00 - Common Work Results.
B. Verify system is ready for start-up with visual inspection and sign off from installing personnel.
C. Start-up motor per equipment manufacturer's recommendations.
D. Provide start-up reports documenting the following:
1. Thermostatic Mixing Valves:
a. Location / Associated Equipment.
b. Manufacturer.
c. Model/ Size.
d. Hot Water Temperature / Discharge Temperature.
2. Pilot Operated Pressure Reducing Valve:
a. Location / Associated Equipment.
b. Manufacturer.
c. Model/ Size.
d. Inlet Pressure / Discharge Pressure.

## 3.6 TESTING

A. Backflow Preventers: Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

1. Data on Device.
2. Type of Assembly.
3. Manufacturer.
4. Model Number.
5. Serial Number.
6. Size.
7. Location.
8. Test Pressure Readings.
9. Data on Testing Firm.
10. Name.
11. Address.
12. Certified Tester.
13. Certified Tester No.
14. Date of Test.
15. Serial Number and Test Data of Gauges.

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

**END OF SECTION 22 10 06**

**SECTION 22 30 05**
**PLUMBING EQUIPMENT**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Water Heaters.
B. Compression Tanks.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 20 05 19 - Meters and Gages.
C. Section 20 10 07 - Valves.
D. Section 20 10 16 - Insulation.
E. Section 26 05 83 - Wiring Connections.

### 1.3 REFERENCE STANDARDS

A. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2013 (ANSI/ASHRAE/IESNA Std 90).
B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2013.
C. ICC (IPC) - International Plumbing Code; 2012.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
    1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
    2. Provide electrical characteristics and connection requirements.
    3. Water heaters (22 30 05 - 001 - A)
    4. Compression Tanks (22 30 05 - 001 - A)
D. Shop Drawings:
    1. Indicate dimensions, size of connections, and performance data.
    2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
    3. Water Heaters (22 30 05 - 001 - A)
    4. Compression Tanks (22 30 05 - 001 - A)
E. Start-Up Report: Indicate start-up results.
    1. Refer to section 20 00 00 - Common Work Results.

2. Water Heaters. (22 30 05 - 004 - A)

F. Project Record Documents: Record actual locations of components.
1. Refer to Section 20 00 00 - Closeout Submittals.
2. Record Documents (20 00 00 - 005 - A)

G. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
1. Refer to Section 20 00 00 - Closeout Submittals.
2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
3. Operation and Maintenance DVD (20 00 00 - 007 - A)
4. Water Heaters.

H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
2. Water Heaters.

## 1.5 WARRANTY

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide five year manufacturer warranty, including parts, materials and labor for defective parts, for the following:
1. Include in Closeout Submittals Book.
2. Water Heaters.
3. Compression Tanks.

# PART 2 PRODUCTS

## 2.1 COMMERCIAL ELECTRIC WATER HEATERS

A. Type: Factory-assembled and wired, electric, vertical storage.
B. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
1. Insulated to meet requirements of ASHRAE 90.1. If factory installed insulation does not meet ASHRAE 90.1 exterior insulate with Insulation from Section 20 10 16 - Insulation and stainless steel jacket to meet requirement of ASHRAE 90.1.

C. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 110 degrees Fahrenheit to 140 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat.
D. Accessories:
1. Water Connections: Brass.
2. Dip tube.
3. Drain Valve, with hose end, cap and chain.
4. Anode: Magnesium.
5. Temperature and Pressure Relief Valve: ASME labelled.
6. Heat trap fittings.
7. Heavy Duty Disconnect Switch:
a. Comply with NEMA KS 1.

b. Conductor Terminations:
   1) Provide mechanical lugs unless otherwise indicated.
   2) Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
c. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
   1) Provide means for locking handle in the ON position where indicated.

E. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 Watts per square inch.
F. Manufacturer:
   1. AO Smith, Series DEN.

**2.2 DIAPHRAGM-TYPE COMPRESSION TANKS**

A. Pressure Vessels: ASME labeled, to ASME BPVC-VIII-1.
B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psig.
D. Manufacturers:
   1. Amtrol Inc. Series ST-C, ASME rated.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm pad location and size.
C. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
D. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

**3.2 EXAMINATION**

A. Verify that piping and equipment are ready to receive work.
B. Verify field measurements are as shown on shop drawings.
C. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
D. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
E. Maintain service clearances.
F. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

G. Examine roughing-in for piping connections to verify actual locations before equipment installation.
H. Coordinate location and size of all equipment pads, prior to floor being poured.
I. Proceed with installation only after unsatisfactory conditions have been corrected.
J. Verify that surfaces are suitable for installation.

**3.3 INSTALLATION**

A. Install equipment in accordance with the following:
   1. Federal, State and Local codes.
   2. Manufacturer's recommendations.
   3. Intentional Plumbing Code
B. Water Heaters:
   1. Furnish heat traps on the cold and hot water piping connected to the water heaters.
   2. Extend pressure relief valve discharge to the floor, aim towards floor drain.
   3. Provide Start-up per section 20 00 00 - Common Work Results.
   4. Provide Training per section 20 00 00 - Common Work Results.
C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
D. Install thermometers on inlet and outlet piping of electric, domestic-water heaters.
E. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
F. Fill domestic-water heaters with water.
G. Coordinate with plumbing piping and related electrical work to achieve operating system.
H. Diaphragm-Type Compression Tank:
   1. Provide steel pipe support, independent of building structural framing members.
   2. Furnish hose end valve to drain tank. Refer to section 20 10 07 - Valves.
   3. Provide pressure gauge and thermometers at pump location. Refer to section 20 05 19 - Meters and Gages.
   4. Furnish isolation valve for tank. Lock handle in open position.
   5. Insulate tank, refer to section 20 10 16 - Insulation.

**3.4 START-UP**

A. Provide Start-up per section 20 00 00 - Common Work Results.
B. Water Heater:
   1. Complete installation and startup checks according to manufacturer's written instructions.

**3.5 TRAINING**

A. Provide Training per section 20 00 00 - Common Work Results.
B. Water Heaters.

**END OF SECTION 22 30 05**

**SECTION 22 40 40**
**PLUMBING FIXTURES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Service Sinks.
B. Emergency Showers.

### 1.2 RELATED REQUIREMENTS

A. Section 07 90 05 - Joint Sealers: Seal fixtures to walls and floors.
B. Section 20 00 00 - Common Work Results.
C. Section 20 05 19 - Meters and Gages.
D. Section 26 05 83- Wiring Connections.

### 1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
C. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2009.
D. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2012.
E. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2013.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device shall be clearly marked up to identify the items, accessories and options to be used on the project. Provide catalog illustrations of fixtures, sizes, utility sizes, trim, and finishes.
    1. Service Sinks (22 40 00 - 002 - A)
    2. Emergency Showers (22 40 00 - 006 - A)
    3. Coordinate final size of sinks and lavatory with counter and cabinets.
D. Manufacturer's Instructions: Indicate installation methods and procedures.
E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
    1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
    2. Service Sinks.
    3. Emergency Showers.
G. Project Record Documents: Record actual installed locations of components and tag numbering.
    1. Refer to Section 20 00 00 - Closeout Submittals.
    2. Record Documents (20 00 00 - 005 - A)

H. Operation and Maintenance Data: Include installation instructions and spare parts lists.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
   3. Operation and Maintenance DVD (20 00 00 - 007 - A)

**1.5 REGULATORY REQUIREMENTS**

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

**1.6 DELIVERY, STORAGE, AND HANDLING**

A. Accept fixtures on site in factory packaging. Inspect for damage.
B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

**1.7 WARRANTY**

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide 3 year warranty, including parts, materials and labor for defective parts, for the following:
   1. Include in Closeout Submittals Book.
   2. Service Sinks.
   3. Emergency Showers.

**PART 2 PRODUCTS**

**2.1 GENERAL**

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

**2.2 SERVICE SINKS (SS-1)**

A. Bowl: ASME A112.19.1; 22 by 18 by 12 inch deep, porcelain enamelled (inside only) cast iron roll-rim sink, with 12 inch high back, concealed hanger, chrome plated strainer, stainless steel rim guard, cast iron P-trap with adjustable floor flange.
   1. Kohler Bannon, K-6714-0 with K-6673.
B. Faucet: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.

**2.3 EMERGENCY SHOWERS**

A. Emergency Shower with Eye-Face Wash (ESH-1): ANSI Z358.1; free standing, self- cleaning, non-clogging stainless steel deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings.
   1. All stainless steel construction.
      a. Bradley S19-314BFSS.
   2. Thermostatic Mixing Valve: Rated for use with emergency fixtures. 26 GPM at 5 PSI. Adjustable temperature setting between 65-90 degrees fahrenheit. Positive shut-off to hot water upon drop in cold water pressure, built in cold water bypass. Dial thermometer.

a. Bradley S19-2200.

B. Emergency Shower with Eye-Face Wash (ESH-2) : ANSI Z358.1; free standing, self- cleaning, non-clogging stainless steel deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings. Insulated and heat traced.
   1. All stainless steel construction, NEMA 4X.
      a. Bradley, S19-304.
   2. Thermostatic Mixing Valve: Rated for use with emergency fixtures. 26 GPM at 5 PSI. Adjustable temperature setting between 65-90 degrees fahrenheit. Positive shut-off to hot water upon drop in cold water pressure, built in cold water bypass. Dial thermometer.
      a. Bradley, S19-2200.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
B. Confirm rough-in and framing of walls and partitions with supports for fixtures and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

**3.2 EXAMINATION**

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
B. Verify that surfaces are suitable for installation.
C. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
D. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
E. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
F. Maintain clearances to combustibles and service clearances.
G. Verify that surfaces are suitable for installation.
H. Verify that field measurements are as shown on the drawings.
I. Proceed with installation only after unsatisfactory conditions have been corrected.
J. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

**3.3 INSTALLATION**

A. Install in accordance with the following:
   1. Federal, state and local codes.

2. Manufacturer's instructions.
3. 36 CFR 1191 and ADA standards.

B. Install each fixture with trap easily removable for servicing and cleaning.

C. Provide chrome plated rigid piping with loose key stops, reducers, escutcheons and flexible connector to domestic water connections. Rough-in and connect to equipment and fixtures.
1. For equipment or fixtures provided under this contract.
2. For equipment or fixtures provided by owner.
3. For equipment or fixtures provided by other contractors.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports and bolts.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05 - Joint Sealers, color to match fixture.

G. Contractor shall be responsible to coordinate the orientation of all plumbing fixtures (i.e. left-hand, right-hand) with ADA requirements and general building conditions.

H. Install thermometers and pressure gages for thermostatic mixing valves. Refer to 20 05 19 - Meters and Gages.

I. Service Sinks:
1. Set floor-mounted basin in leveling bed of cement grout.
2. Install water-supply piping with stop on each supply to each sink faucet.
a. Install stops in locations where they can be easily reached for operation.
3. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant.

J. Emergency Showers:
1. Set floor-mounted fixtures in leveling bed of cement grout.
2. Install water-supply piping with stop on each supply to each fixture.
a. Install stops in locations where they can be easily reached for operation.
3. Seal joints between wash fountains and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant.

## 3.4 START-UP

A. Provide Start-up per section 20 00 00 - Common Work Results.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

C. Adjust sensors for automatic flush valves, faucets and activators.

## 3.5 CLEANING

A. Clean plumbing fixtures and equipment.

## 3.6 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 22 40 40**

**SECTION 23 05 17**
**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.

### 1.2 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: For each type of product indicated.

## PART 2 PRODUCTS

### 2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

### 2.2 STACK-SLEEVE FITTINGS

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. Smith, Jay R. Mfg. Co.
   2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

### 2.3 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

**2.4 SLEEVE-SEAL FITTINGS**

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. Presealed Systems.
B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

**2.5 GROUT**

**PART 3 EXECUTION**

**3.1 SLEEVE INSTALLATION**

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
   3. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   4. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

**3.2 STACK-SLEEVE-FITTING INSTALLATION**

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 00 - Firestopping.

**3.3 SLEEVE-SEAL-SYSTEM INSTALLATION**

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

**3.4 SLEEVE-SEAL-FITTING INSTALLATION**

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

**3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE**

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system or Sleeve-seal fittings .
    a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system, Galvanized-steel wall sleeves with sleeve-seal system, Galvanized-steel-pipe sleeves with sleeve-seal system, or Sleeve-seal fittings.
    a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, or Stack-sleeve fittings.
4. Interior Partitions: Galvanized-steel-pipe sleeves or PVC-pipe sleeves.

**END OF SECTION 23 05 17**

**SECTION 23 09 13**
**INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Time clocks.
B. Time clocks.
C. Miscellaneous accessories.

### 1.2 RELATED REQUIREMENTS

A. Section 22 05 19 - Meters and Gauges for Plumbing Piping: Thermometer sockets and gauge taps.
B. Section 23 05 19 - Meters and Gauges for HVAC Piping: Thermometer sockets and gauge taps.
C. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.
D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

### 1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, marked up to identify the items to be used on the project.
D. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
E. Manufacturer's Instructions: Provide for all manufactured components.
F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
    1. Revise shop drawings to reflect actual installation and operating sequences.
G. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
H. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Thermostats and Other Exposed Sensors: One of each type.

**1.5 WARRANTY**

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

**PART 2 PRODUCTS**

**2.1 EQUIPMENT - GENERAL**

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

**2.2 TIME CLOCKS**

A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

A. Verify existing conditions before starting work.
B. Verify that systems are ready to receive work.
C. Beginning of installation means installer accepts existing conditions.
D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
F. Ensure installation of components is complementary to installation of similar components.
G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

**3.2 INSTALLATION**

A. Install in accordance with manufacturer's instructions.
B. Coordinate voltage and power requirements of each device with installation and contractor responsible for wiring device.
C. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 42 inches above finished floor. Align with lighting switches and humidistats. Refer to Section 26 27 26.
D. Mount outdoor reset thermostats and outdoor sensors indoors with sensing elements outdoors with sun shield.
E. Provide separable sockets for liquids and flanges for air bulb elements.
F. Provide isolation (two position) dampers of parallel blade construction.
G. Actuators
   1. Install in an accessible location, with room for actuator removal and service. Adjust the actuator to provide tight shutoff. Provide stem indicator and adjust to indicate proper travel.

2. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

H. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

I. Install "on/off/auto" selector switches to override automatic interlock controls when switch is in "on" position.

J. Power
   1. Power feeds for the building automation system, control panels or to operate the controls shall be fed from a 120 volt panel.
   2. Any breaker indicated as "Building Controls" is available for the controls to furnish and install the associated wiring and conduit in accordance with Section 26 05 83 - Wiring Connections. Electrical material and installation shall be in accordance with appropriate requirements of Division 26. The contractor shall extend power wiring to the location required by the controls device.
   3. If additional circuits or power is required for the Control system, it is the contractors responsibility to provide the breaker, wiring and conduit in accordance with Section 26 05 83 - Wiring Connections. Electrical material and installation shall be in accordance with appropriate requirements of Division 26. The contractor shall extend power wiring to the location required by the controls device.

K. Wire and Cable
   1. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
   2. Wire and Cable shall be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A.
   3. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire to wire connections shall be at a terminal block.
   4. Instrumentation grounding shall be installed per the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system.
   5. Test installed ground rods as specified in IEEE 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings.

## 3.3 ADJUSTING

A. The AMD shall not be adjusted to match field measurements without approval from the consulting mechanical engineer when installations meet or exceed manufacturer’s suggested placement guidelines. Field adjustment, when required shall be accomplished using transmitter firmware that calculates adjustment gain and offset coefficients based on one or two reference measurements.

## 3.4 START-UP

A. Perform start-up in accordance with Section 22 05 00

**3.5 TRAINING**

A. Perform training in accordance with Section 22 05 00.

**END OF SECTION 23 09 13**

**SECTION 23 31 00**
**HVAC DUCTS AND CASINGS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Metal Ductwork.
B. Duct Cleaning.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 23 05 94 - Testing, Adjusting, and Balancing for HVAC.
C. Section 23 33 00 - Air Duct Accessories.

### 1.3 REFERENCE STANDARDS

A. ASHRAE Std 126 - Method of Testing HVAC Air Ducts 2020.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
C. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip 2022a.
D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.
E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021a.
F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023.
I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish and accessories. Manufacturer's data sheets on each item of equipment and device shall be clearly marked up to identify the items, accessories and options to be used on the project.
   1. Metal Duct (23 31 00 - 001 - A)
D. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for ductwork systems.
   1. Metal Duct (23 31 00 - 001 - A)
   2. Coordination Drawings (20 00 00 - 004 - A)

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
   1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
   2. Metal Duct
F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Record Documents. (20 00 00 - 005 - A)

**1.5 WARRANTY**

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide 25 year manufacturer's warranty .
   1. Include in Closeout Submittals Book.
   2. Metal Duct

**PART 2 PRODUCTS**

**2.1 DUCT ASSEMBLIES**

A. Regulatory Requirements: Construct ductwork to NFPA 90A standards and schedule on drawings.

**2.2 MATERIALS**

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
B. Un-Galvanized Steel for Ducts: ASTM A1008/A1008M, Designation CS, cold-rolled commercial steel.
C. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
D. Stainless Steel for Ducts: ASTM A480/A480M, Type 304.
E. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
F. Hanger Rod:
   1. ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
   2. Humid or harsh environments, stainless steel continuously threaded rod.

**2.3 DUCTWORK FABRICATION**

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
D. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide plenum box sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

**2.4 FACTORY- OR SHOP-APPLIED ANTIMICROBIAL COATING**

A. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
B. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
C. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
D. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
E. Shop-Applied Coating Color: Black.
F. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.

**3.2 EXAMINATION**

A. Verify that surfaces are suitable for installation.
B. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
C. Verify that equipment are ready to receive work.
D. Verify field measurements are as shown on shop drawings.
E. Maintain clearances to combustibles and service clearances.
F. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

A. Install in accordance with the following:
    1. Federal, State and Local codes.
    2. Manufacturer's instructions.
    3. SMACNA 1966.
B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
F. Use double nuts and lock washers on threaded rod supports.

**3.4 CLEANING**

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

**END OF SECTION 23 31 00**

**SECTION 23 33 00**
**AIR DUCT ACCESSORIES**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Backdraft dampers - metal.
B. Duct test holes.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 23 31 00 - HVAC Ducts and Casings.
C. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

### 1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
   1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
E. Project Record Drawings: Record actual locations of access doors and test holes.
   1. Record Drawings (20 00 00 - 004 - A)

### 1.5 WARRANTY

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide 3 year warranty, including parts, materials and labor for defective parts, for the following:
   1. Include in Closeout Submittals Book.

## PART 2 PRODUCTS

### 2.1 BACKDRAFT DAMPERS - METAL

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

### 2.2 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

## 2.3 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.
B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch, minimum.

# PART 3 EXECUTION

## 3.1 INTERFACE WITH WORK OF OTHER SECTIONS

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

## 3.2 EXAMINATION

A. Verify that surfaces are suitable for installation.
B. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
C. Verify that piping and equipment are ready to receive work.
D. Verify field measurements are as shown on shop drawings.
E. Electrical:
   1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for electrical connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
F. Controls:
   1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
   2. Verify rough-in for control connections to verify actual locations before installing.
   3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
G. Maintain clearances to combustibles and service clearances.
H. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
C. Provide duct test holes where indicated and required for testing and balancing purposes.

**END OF SECTION 23 33 00**

**SECTION 23 34 13**
**AXIAL HVAC FANS**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Propeller fans.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 20 05 48 - Supports for Piping, Ductwork and Equipment.
C. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
D. Section 23 33 00 - Air Duct Accessories.
E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
F. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
G. Section 26 05 26 - Grounding and Bonding for Electrical Systems.

### 1.3 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards Current Edition.
B. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).
C. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014 (Reaffirmed 2020).
D. AMCA 99 - Standards Handbook 2016.
E. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
F. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
G. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
H. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2022.
I. NEMA MG 1 - Motors and Generators 2021.
J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2021.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Common Work Results.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
    1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
    2. Include mounting brackets, control panels, thermostat and options.
    3. Include Wiring Diagrams: Power, signal and control wiring.
    4. Propeller fans (23 34 13 - 001 - A)
D. Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
    1. Propeller fans. (23 34 13 - 001 - A)

E. Start-up Report: Indicate start-up results.
   1. Refer to section 20 00 00 - Common Work Results.
   2. Propeller fans (23 34 13 - 002 - A)
F. Test Reports: Indicate performance data for adjustable axial fan blades for at least five blade settings, including maximum.
G. Manufacturer's Instructions: Indicate installation instructions.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
   1. Submit under Operation and Maintenance Data books (20 00 00 - 006 -A)
   2. Propeller fans
I. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Record Documents (20 00 00 - 005 - A)
J. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
   1. Refer to Section 20 00 00 - Closeout Submittals.
   2. Operation and Maintenance Data Books (20 00 00 - 006 - A)
   3. Operation and Maintenance DVD (20 00 00 - 007 - A)

## 1.5 WARRANTY

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.
B. Provide 3 year warranty, including parts, materials and labor for defective parts, for the following:
   1. Include in Closeout Submittals Book.
   2. Propeller fans.

# PART 2 PRODUCTS

## 2.1 PROPELLER FANS

A. MANUFACTURERS
   1. Greenheck, SB series.
   2. S&P fans
   3. Substitutions: See Section 01 6000 - Product Requirements.
B. Direct Drive, wall mounted sidewall propeller fan for exhaust or supply.
C. Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, provided with V-belt drive.
D. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.
E. Accessories:
   1. Outlet Damper: Multiple blade with offset hinge pin, blades linked, line voltage motor drive, power open, spring return.
   2. Safety Screens: Expanded galvanized metal over inlet, motor, drive; to comply with 29 CFR 1910.
   3. Controller: Solid-state speed controller.

# PART 3 EXECUTION

## 3.1 INTERFACE WITH WORK OF OTHER SECTIONS

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

## 3.2 EXAMINATION

A. Verify that surfaces are suitable for installation.
B. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
C. Verify field measurements are as shown on shop drawings.
D. Electrical:
    1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for electrical connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
E. Controls:
    1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for control connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
F. Maintain clearances to combustibles and service clearances.
G. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.3 INSTALLATION

A. Install in accordance with the following:
    1. Federal, state and local codes.
    2. Manufacturer's instructions.
    3. NFPA 90A.
    4. NFPA-70 National Electric Code.
B. Install equipment level and plumb.
C. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
D. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.
E. Install with resilient mountings and with flexible electrical leads.
F. Install flexible connections specified in Section 23 33 00 between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and axial fan while running.
G. Install fan restraining snubbers; refer to Section 20 05 48 - Supports for Piping, Ductwork and Equipment. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
H. Provide fixed sheaves required for final air balance.
I. Provide safety screen where inlet or outlet is exposed.

## 3.4 START-UP

A. Perform start-up in accordance with Section 20 00 00 - Common Work Results.

1. Propeller fans.

**3.5 TRAINING**

A. Perform training in accordance with Section 20 00 00 - Common Work Results.
   1. Propeller fans.

**END OF SECTION 23 34 13**

**SECTION 23 81 28**
**MINI SPLIT-SYSTEM HEATING AND COOLING**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Indoor Ductless Fan & Coil Units.
B. Air Cooled Condensing Units.
C. Controls.
D. Line Sets.
E. Mounting Supports.

### 1.2 RELATED REQUIREMENTS

A. Section 20 00 00 - Common Work Results.
B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
D. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

### 1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute; 2008.
B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute; 2004.
C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2013 (ANSI/ASHRAE Std 15).
D. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2010.
E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2012.
F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association; 2012.
G. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

### 1.4 SUBMITTALS

A. See Section 20 00 00 - Administrative Requirements, for submittal procedures.
B. Listed manufacturers and series are for reference only and do not promote any single product. Series are provided for reference, and should not be used as an ordering model number. Accessories and options may be custom components purchased separately.
C. Product Data: Provide manufacturer's most current catalog data sheet for equipment indicating rough-in size, finish, and accessories. Manufacturer's data sheets on each item of equipment and device, shall be clearly marked up to identify the items, accessories and options to be used on the project.
    1. Design Data: Indicate refrigerant pipe sizing.
    2. Air cooled condensing units (23 81 28 - 001 - A)

3. Indoor ductless fan & coil units (23 81 28 - 001 - A)

D. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
1. Air cooled condensing units (23 81 28 - 001 - A)
2. Indoor ductless fan & coil units (23 81 28 - 001 - A)

E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
1. Air cooled condensing units (23 81 28 - 001 - A)
2. Indoor ductless fan & coil units (23 81 28 - 001 - A)

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
1. Submit under Operation and Maintenance Data books (20 00 00 - 006 - A)
2. Air Cooled Condensing Units.
3. Indoor ductless Fan & Coil Units.

G. Start-up Report: Indicate start-up results.
1. Refer to section 20 00 00 - Common Work Results.
2. Air cooled condensing units (23 81 28 - 002 - A)
3. Indoor ductless fan & coil units (23 81 28 - 002 - A)

H. Project Record Documents: Record actual locations of components and connections.
1. Air cooled condensing units (20 00 00 - 004 -.A)
2. Indoor ductless fan & coil units (20 00 00 - 004 - A)

I. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

## 1.5 WARRANTY

A. See Section 20 00 00 - Common Work Results, for extended warranty requirements.

B. Provide 5 year warranty, including parts, materials and labor for defective parts, for the following:
1. Include in Closeout Submittals Book.
2. Air Cooled Condensing Units.
3. Indoor ductless Fan & Coil Units.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator; auxiliary electric heat.
2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

## 2.2 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
1. Fan: Line-flow fan direct driven by a single motor.

2. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
   1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

C. Wall Mounted Manufacturers:
   1. Mitsubishi Series PKA.
   2. LG Series.
   3. Carrier.

D. Condensate lift pump, accessory item, which fits into split system with pigtail and quick connector to electric power wiring of indoor unit.
   1. Manufacturers:
      a. Mitsubishi Series SI3100-230.
      b. LG Series FP 2406/2.

E. Disconnect switch, three pole with thermal overloads sized for associated equipment.
   1. Manufacturers:
      a. Mitsubishi Series TAZ-MS303.
      b. LG Series.

**2.3 AIR COOLED CONDENSING UNITS**

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
   1. Refrigerant: R-410A.
   2. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
   3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Compressor: AHRI 520; hermetic, two speed 1800 and 3600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.

C. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
   1. Condenser Fans: Direct-drive propeller type.
   2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.

D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
   1. Provide thermostatic expansion valves.
   2. Provide heat pump reversing valves.

E. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

F. Manufacturers:

1. Mitsubishi Series PUY.
2. LG Series LSU.
3. Carrier.

**2.4 CONTROLS**

A. Operating Controls:
   1. Control by room thermostat to maintain room temperature setting.
   2. Manufacturers:
      a. Mitsubishi Series PAR-SL97A-1.
      b. LG Series PREMTB10U.

**2.5 LINE SETS**

A. Pre-insulated line sets, sized according to unit manufacturer's recommendations. 1/2 thick elastomeric Insulated ACR cooper tubing, in 50 foot lengths. Sealed ends with charge and isolation valves.
   1. Manufacturers:
      a. Mitsubishi Series MPLS.
      b. LG Series.

B. Piping and insulation covering system. Plastic raceway material with fittings for bends and tees.
   1. Manufacturers:
      a. Mitsubishi Series Line Hide system.
      b. LG Series.

**2.6 MOUNTING SUPPORTS**

A. Wall mounted condensing unit supports, mild carbon steel, two piece bracket for wall mounting, polyester powder coating.
   1. Manufacturers:
      a. Mitsubishi Series CWMB1.
      b. LG Series.

B. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.
   1. Manufacturers:
      a. Monarch precast series BB-1.

**PART 3 EXECUTION**

**3.1 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Confirm framing and support members.
B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.
C. Confirm rough-in locations and power requirements before rough-in installation. Refer to Section 26 05 83 - Wiring Connections.

**3.2 EXAMINATION**

A. Verify that surfaces are suitable for installation.
B. Verify that field measurements are as shown on the drawings.

C. Examine areas to receive equipment for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
D. Verify that piping and equipment are ready to receive work.
E. Verify field measurements are as shown on shop drawings.
F. Electrical:
    1. Verify electrical power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for electrical connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility prior to ordering equipment.
G. Controls:
    1. Verify signal power, voltage, phase and current is available and of the correct characteristics.
    2. Verify rough-in for control connections to verify actual locations before installing.
    3. Verify motor type and VFD or disconnect type for compatibility with control sequence and control devices prior to ordering equipment.
H. Maintain clearances to combustibles and service clearances.
I. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.3 INSTALLATION**

A. Install in accordance with the following:
    1. Federal, state and local codes.
    2. Manufacturer's instructions.
    3. NFPA 90A.
    4. National Electric Code.
B. Install equipment level and plumb.
C. Connect wiring according to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
D. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.
E. Install in accordance with NFPA 90A and NFPA 90B.
F. Install refrigeration systems in accordance with ASHRAE Std 15.
G. Pipe condensate drain from unit to nearest floor drain.

**3.4 START-UP**

A. Perform start-up in accordance with Section 20 00 00 - Common Work Results.
    1. Air cooled condensing units.
    2. Indoor ductless fan & coil units.

**3.5 TRAINING**

A. Perform training in accordance with Section 20 00 00 - Common Work Results.
    1. Air cooled condensing units.
    2. Indoor ductless fan & coil units.

**END OF SECTION 23 81 28**

# SECTION 25 50 01

# PROCESS CONTROL SYSTEM GENERAL REQUIREMENTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. The Contractor shall obtain the services of a subcontractor who shall provide a complete integrated Process Control System (PCS) consisting of motor control centers, variable frequency drives, control panels, instrumentation, and programmable controller system hardware and software, as shown on the Process Control System Drawings and as specified in Division 25. This subcontractor will hereafter be referred to as the Process Control System Supplier. The System Supplier shall have total responsibility for the design, programming, testing, start-up and implementation of the Process Control System.

2. The Process Control System Supplier shall be one of the following System Integrators. No other suppliers will be accepted without approval prior to the bid:

Allied Control Services, Inc.
611 Garfield Ave.
West Point, PA 19486
215-699-2855
Contact: Matt Mamzic

Micro-Tech Designs, Inc.
4312 Black Rock Rd.
Suite 1
Hampstead, MD 21074
410-239-2885
Contact: Josh Whitley

S-L Controls, Inc.
2140 Renard Court
Annapolis, MD 21401
410-841-6810
Contact: Steve Vinceguerra

Optimum Controls Corp.
1301 Rosemount Blvd.
Reading, PA 19604
610-375-0990
Contact: Jim Brunell

Trijay Systems, Inc.
10 Maple Avenue
Line Lexington, PA 18932
215-997-5833
Contact: Jim Arevalo

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronic Engineers |
| ISA | International Society of Automation |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories, Inc. |

B. Quality Control:

1. All components of the Process Control System shall be new and of the most current and proven design. All components shall be suitable for the intended application and shall be installed and wired in strict accordance with the manufacturer's requirements. The System Supplier shall provide all necessary transformers, power supplies, fusing, and grounding required to meet the manufacturer's requirements.

2. The complete system must comply with all Federal, State, Municipal, or other authority's laws, rules, or regulations.

3. All motor control centers and control panels, and their components and materials, shall bear the label of the Underwriters' Laboratory. All control panels shall be UL listed as a complete assembly.

C. Equipment Manufacturers:

1. The Process Control System Supplier shall base his bid on providing the manufacturers specified under Division 25 for all equipment furnished for the System. No substitutes will be allowed.

## 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit required number of detailed shop drawings for all equipment being provided for the Process Control System. Shop drawings shall be submitted within 90 days of the date of Notice to Proceed.

2. Shop drawings shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly, and indexed. Separate shop drawing submittals shall be made for each of the following:

   a. Motor Control Centers
   b. Variable Frequency Drives
   c. Control Panels
   d. Instrumentation
   e. Programmable Controller System Hardware and Software
   f. HMI Software

3. Refer to specification sections for specific shop drawing requirements.

4. The System Supplier shall submit a complete set of engineered drawings for the Motor Control Centers, Control Panels, and Programmable Controller system hardware. These engineered drawings shall be similar to the Contract PCS Drawings, and shall be done by the System Supplier using AUTOCAD. The drawing size shall be 11"x17". These drawings shall include, but not be limited to, the following:

   a. Motor Control Center elevation showing all unit locations, door mounted devices and dimensions.
   b. A chart for the Motor Control Center indicating nameplate engraving, starter size and type, circuit breaker size and type, transformer size, special controls, motor horsepower, and overload heater size, for each Motor Control Center unit.
   c. Three line wiring diagrams for each motor control center unit showing power and control wiring, unit devices, terminal numbers, and interconnecting wiring.

d. Control panel elevation, details, front and back panel layout, and wiring diagrams showing terminal numbers and interconnecting wiring. The control panel layout drawings shall include dimensions for the location of all panel-mounted devices.
e. Programmable controller system block diagram, power wiring diagrams and I/O wiring diagrams showing terminal numbers and interconnecting wiring.

B. Installation, Operation and Maintenance Manuals:

1. Submit required number of copies of installation, operation and maintenance manuals for all equipment being provided for the Process Control System.

2. Installation, operation and maintenance manuals shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. Separate binders shall be submitted for each of the following:

a. Motor Control Centers
b. Variable Frequency Drives
c. Control Panels
d. Instrumentation
e. Programmable Controller System Hardware and Software
f. HMI Software

**PART 2 PRODUCTS**

**2.1 SEE SPECIFIC SECTIONS FOR PRODUCTS**

**PART 3 EXECUTION**

**3.1 COORDINATION**

A. The Process Control System Supplier shall attend an initial coordination meeting with the Engineer, the Contractor and the Owner to review the scope of the project and the project schedule.

B. The Process Control System Supplier shall attend coordination meetings with the equipment manufacturers listed below to review the control interface with vendor provided equipment. The coordination meetings will be held at the Smithsburg WWTP.

1. SBR Equipment Manufacturer – Aqua-Aerobics

2. UV System Manufacturer - Trojan

C. The Process Control System Supplier shall be responsible for coordinating all vendor provided control panels with the Process Control System.

**3.2 FACTORY ACCEPTANCE TEST**

A. The System Supplier shall conduct a factory acceptance test for the Process Control System prior to shipment of the equipment. The factory test shall be conducted at the supplier's facility and shall demonstrate the control system was designed and performs in accordance with the Specifications and Drawings. All equipment furnished for the Process Control System shall be assembled and inter-wired so that it functions as a complete system for the factory acceptance test.

B. The System Supplier shall provide all necessary equipment and hardware required to conduct the factory test.

C. The factory acceptance test shall demonstrate the proper operation of all control logic described in the Description of Operation, and all system hardware and software. The factory test shall be witnessed by the Engineer and the Owner.

D. Submit an itemized test procedure and schedule for the factory acceptance test to the Engineer for his review prior to the actual test.

**3.3 RECORD DRAWINGS**

A. Submit required number of as-built drawings for the Process Control System prior to the delivery of any equipment to the site. Provide an as-built drawing in the control panel.

B. Following start-up and commissioning of the system, the System Supplier shall make all necessary changes to the as-built drawings and re-submit required number of final as-built drawings. A final as-built drawing shall also be provided in the control panel.

**3.4 SYSTEM INSTALLATION, START-UP AND COMMISSIONING**

A. System Installation:

1. The System Supplier shall provide on-site supervision and advice to the installing contractor to insure the system is installed in accordance with the specifications and the manufacturer's requirements.

2. All field wiring to the equipment furnished by the System Supplier shall be performed under the electrical portion of the Contract unless noted otherwise on the Drawings.

B. System Start-Up:

1. Start-up the control system by energizing the system equipment and testing the operation of all hardware, software, process control logic, and all customized software programs.

2. All start-up and testing shall be scheduled, performed in an orderly sequence, and conducted in the presence of and to the satisfaction of the Engineer and the Owner.

C. System Commissioning:

1. Calibrate all instrumentation, and place the complete process control system into operation. The commissioning of the system shall include the overall calibration and tuning of all control loops and sequences to provide stable control of the process. The validity of all inputs and outputs for the system shall be checked and verified during the system commissioning.

2. The System Supplier shall provide a minimum of two (2) people on-site for the length of time necessary for system installation, start-up and commissioning.

**3.5 FINAL ACCEPTANCE TEST**

A. Following the commissioning of the Process Control System, and the issuance of the Certificate of Substantial Completion to the Contractor by the Engineer, a final acceptance test shall be conducted for a period of 30 consecutive days. This test shall be scheduled with the Owner and the Engineer and shall not begin until the System Supplier receives written approval to start. During that time period, the system shall operate satisfactorily and in compliance with the Specifications. The System Supplier shall promptly correct any problems that occur during the acceptance test.

B. Following the successful completion of the final acceptance test, a certificate of final acceptance will be issued to the System Supplier.

**3.6 EXPANSION OF SYSTEM I/O**

A. The System Supplier shall include in his cost for this Contract the addition of twenty (20) I/O points to the system as directed by the Engineer. These additional I/O points will originate from the spare I/O. The Supplier's allowance shall include all costs to add these points to the system including wiring, drawing changes, programming, and field verification.

**3.7 ADDITIONAL RELAYS**

A. The System Supplier shall include in his cost for this Contract the addition of ten (10) relays that may be required by the control system. The cost for the additional relays shall include the relays, wiring, drawing changes, and field verification.

**3.8 ADDITIONAL SOFTWARE CONFIGURATION AND PROGRAMMING**

A. The System Supplier shall include in his cost for this Contract 80 additional manhours of on-site time for software configuration and programming. This time shall be utilized for changes and/or additions that may be required after the commissioning of the system. The Supplier's cost for these additional manhours shall include software documentation changes, and updates to the O&M Manuals. The additional programming and configuration shall be performed during the one-year warranty period.

**3.9 TRAINING**

A. During the Final Acceptance Test, the System Supplier shall arrange for the instruction and training of plant personnel at the plant site in the operational procedures of the system. At the end of this period, plant personnel shall have, as determined by the Engineer, sufficient knowledge to operate the system. This training shall be for six people for two (2) days. This training shall be in addition to the training specified in the other Division 25 sections.

**END OF SECTION 25 50 01**

# SECTION 25 50 10

# MOTOR CONTROL CENTER

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish and install a new motor control center as shown on the Drawings. The motor control center shall include required number of vertical sections, main breaker, power monitor, transient voltage surge suppressor, circuit breakers, combination type motor starters, variable frequency drives, relays, selector switches, push buttons, pilot lights, control transformers and special controls as shown on the Drawings and specified herein.

2. See Section 25 50 11 for the variable frequency drives.

B. Special Requirements:

1. The Motor Control Center shall be provided by the Process Control System Supplier.

2. The Drawings indicate certain motor starters to be energized by a programmable controller output. If the current rating of the output is not sufficient to energize the starter directly, provide an interposing relay in the motor starter compartment and wire the relay as required to energize the starter. All motor starters shall be furnished with a surge suppressor.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories, Inc. |

1. All internal conductors are to be of sufficient cross-sectional area copper to carry the rated ampere load and not exceed the maximum heat rise above ambient temperature specified by UL and NEMA.

B. Quality Control:

1. The motor control center shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Freestanding Vertical Sections
b. Main Circuit Breaker
c. Power Monitor
d. Transient Voltage Surge Suppressor
e. Thermal-Magnetic Type Circuit Breakers
f. Motor Circuit Protector Type Circuit Breakers
g. Magnetic Across-the-Line Motor Starters
h. Control Transformers
i. Relays
j. Selector Switches
k. Push Buttons
l. Pilot Lights
m. Elapsed Time Meters
n. Special Controls
o. Engineered Control Diagrams and Connection Diagrams
p. Nameplate Schedules

**1.4 MANUFACTURER**

A. The motor control center shall be Allen-Bradley Bulletin 2100.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Motor Control Center Structure and Configuration:

1. The Motor Control Center shall be NEMA Type 1, gasketed. Wiring shall be NEMA Class 1, Type B. The motor control center shall have a main breaker to feed the horizontal bus. Provide lugs of adequate size to terminate incoming cables. The motor control center shall be furnished with a ground bus, and a neutral bus, as indicated on the Drawings.

2. The motor control centers shall be rated at 480 volts, 3 phase, 4 wire, 60 Hz and shall be braced to withstand a short circuit current of 65,000 rms symmetrical amperes.

3. Motor starter units shall be combination type with a molded case circuit breaker. Control voltage for units shall be 120 volts.

4. The motor control center shall consist of vertical sections bolted together to form a rigid, freestanding assembly.

5. Vertical sections shall be formed of 13 gauge hot rolled steel with uniform blemish-free surfaces. Top and bottom structural parts shall be 10 gauge. End closing plates shall be 12 gauge, and unit parts and doors shall be 14 gauge. Base channels shall be provided constructed of rugged steel to easily withstand the stress of transit and moving the control center into position. Bolt holes in the base channels shall be provided in all sections for the purpose of bolting the control center to the floor. Steel removable lifting angles shall be provided on the top of the sections for convenience in handling the control center.

6. Each section, to comply with standards of NEMA, shall be approximately 90" high excluding lifting angles and base channels. It shall be approximately 20" deep by 20" to 35" wide, as indicated on the Drawings.

7. End sections shall have end-closing plates, which can be removed for the addition of future sections. The top plate shall be of a removable one-piece construction for added convenience in cutting conduit holes. Removable blank plates flanged on all 4 sides and having captive screws shall cover all unused unit spaces.

B. Main Circuit Breaker:

1. Main circuit breaker shall be thermal magnetic molded case type, service entrance rated, individually mounted and identified. Main circuit breaker shall have quick-make, quick-break mechanism and shall visually indicate whether the breaker is closed, open or tripped. The main breaker shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity shall be 65,000 amperes symmetrical at 480 volts.

C. Power Monitor:

1. Provide a power monitor in motor control centers where indicated on the Drawings to provide complete electrical metering. The power monitor shall be microprocessor based and shall be furnished complete with current transformers. The power monitor shall be an Allen-Bradley Power Monitor 500.

2. The power monitor shall be furnished with an alarm contact for remote indication of a power failure. This contact shall be wired to terminals in the MCC cubicle for wiring to the plant PLC System.

D. Transient Voltage Surge Suppressor:

1. A transient voltage surge suppressor shall be furnished in motor control centers where indicated on the Drawings. The surge suppressor shall be UL 1449 Second Edition Listed (1998). Unit shall protect all modes (L-L, L-N, L-G, N-G) applicable. Unit shall have 240kA of surge capacity per phase with a let-thru voltage of less than 1500V L-L and 700V L-G. A disconnecting means shall be provided ahead of the surge suppressor so the unit can be serviced without de-energizing the service.

2. Surge suppressor shall have AC tracking filter with EMI/RFI filtering. Each module shall be fused individually, thermally protected, and have LED indication.

3. The surge suppressor shall be furnished with a dry alarm contact to indicate a failure of any module. The alarm contact shall be wired to terminals in the MCC cubicle for wiring to the plant PLC System.

4. TVSS unit shall be provided and installed by the MCC manufacturer. Surge suppressor shall be ASCO Transient Eliminator XGA Series.

E. Horizontal Wireways:

1. Adequate conduit entrance space and wire entry room shall be provided at both the top and bottom of each section. The bottom horizontal wireway shall be 12" and the top horizontal wireway shall be 6" and both shall extend through the length and depth of the control center section with openings between sections. Covers over these wireways shall be equipped with captive type screws to prevent loss of hardware during installation. These wireways shall be isolated from the bus bars.

F. Vertical Wireways:

1. A vertical wire trough located on the right-hand side of each standard section and having a cross-sectional area of not less than 28 sq.in. shall extend from the top horizontal wire trough to the bottom horizontal wire trough for the purpose of routing user's motor and control wires to the control units. The wire trough shall be isolated from the bus bars to guard against accidental contact. A separately hinged door having captive type screws shall cover the vertical wire trough for safe and easy access to wiring without disturbing control units.

2. Wire ties shall be furnished in the vertical wire trough to group and securely hold wires in place for a neat, orderly installation.

3. Where wire access ports between unit spaces and vertical wire trough are open, shutters shall be provided to prevent items, such as a fish tape, from accidentally entering the unit space. Snap-in wire grommets shall be provided in wire access ports for size 2 units and smaller for isolation and added protection of small wires. For larger units, snap-in wire guards shall be provided for added protection of larger wires.

G. Vertical Sections:

1. Each vertical section shall be divided into compartments, each containing a combination starter or other control assembly as indicated on the Drawings. Power shall be provided to these compartments from the main bus by bus bars extending the full height of the unit. Sections shall also be provided with horizontal spaces at the top and at the bottom, which shall line up with adjacent section to form horizontal wiring raceways along the entire length of the control center.

H. Compartments:

1. Compartments shall be built in interchangeable combinations of modular heights. A full vertical section shall contain six equal NEMA size l modular compartments exclusive of top and bottom wiring spaces. Starter compartments shall not be less than 12" high. Only l/2 and integral multiples of the basic module will be allowed. Compartments for NEMA size 4 and smaller starters shall be draw out type.

2. Guide rails shall be provided in the structure for supporting and aligning a unit during its removal or replacement. Draw out units shall have pressure type, line disconnecting stabs of high strength alloy and shall be held in place by means of quick acting, captive machine screw fasteners arranged so the units can be removed or remounted readily without access to the rear of the structure. Each compartment whether draw out or stationary, shall be enclosed and effectively baffled to isolate any fault which may occur and shall be covered by an individual door fixed to the structure with a continuous full length piano hinge or two (three for doors over 36" high) semi-concealed, heavy-duty, pin type hinges. Doors shall be secured with captive, quick acting machine screw fasteners and shall be arranged to completely cover all live parts whether the draw out unit is present or not.

I. Bus Bars:

1. Main horizontal bus bars rated as indicated on Drawings but not less than 600 amperes shall be provided at the top or center of the control center and extend its entire length, except when cut and supplied with splice bars to divide the control center for ease in handling or when section is indicated on Drawings to be furnished without bus.

2. Horizontal bus bars of copper shall be mounted edge-to-edge to provide greater mechanical strength.

3. Vertical copper bus bars shall be rated not less than 300 amperes for adequate current carrying capacity in a variety of plug-in applications.

4. Horizontal and vertical bus bars shall be electrolytically tin plated copper. Connections between horizontal and vertical busses shall be joined by bolts, conical spring washers for constant pressure joints and self-clinching nuts to allow joint maintenance from the front.

5. High strength glass reinforced alkyd insulators shall be used as bus supports and as unit plug-in insulators. Bus and plug-in insulators shall be red to indicate the proximity of energized bus parts.

6. The temperature rise, above ambient temperature outside the enclosure, of bus bars and connections shall not exceed 50°C and that of connections to insulated cable shall not exceed 45°C when operated continuously at rated current. Buswork, wiring and equipment shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 480 volts or as noted on the Drawings.

7. A copper ground lug shall be provided in each incoming line vertical section capable of accepting a #8 to 250 MCM cable. A horizontal and vertical copper ground bus shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout the control center except where splits are necessary for ease of shipment and handling; in which case, splice bars shall be provided. Ground bus shall be tin plated copper and have a cross-sectional area of equal to 28% of the main horizontal bus cross-sectional area. Horizontal ground bus shall be located at the bottom of the motor control center.

J. Bus Barriers:

1. Insulated horizontal and vertical bus barriers shall be furnished to reduce the hazard of accidental contact. These barriers shall have a red color to indicate proximity to energized busses. Vertical bus barriers shall have interlocking front and back pieces to give added protection on all sides and shall segregate the phases from each other. Small, separate openings in the vertical bus barriers shall permit unit plug-in contacts to pass through and engage the vertical bus bars.

2. Bottom bus covers shall be provided below the vertical bus to protect the ends of this bus from contact with fish tapes or other items entering the bottom of the enclosure. Unused plug-in openings shall have plastic snap-in closing plates.

K. Unit Plug-In:

1. Unit plug-in contacts shall be provided for size l through size 5 motor starters and for branch circuit breakers.

2. The plug-in connection shall be 2-point connection for each phase designed to tighten during heavy current surge. The plug-in fingers shall be tin plated to yield a low resistance connection and shall be backed by spring steel clips to provide high-pressure connection points. Contact fingers shall be mounted in their support so these fingers become floating and self-aligning to allow solid seating onto the vertical bus bars.

L. Unit Doors:

1. Each unit shall have a door securely mounted with hinges, which allow the door to swing open a minimum of 112 degrees. Unit doors shall be fastened to the stationary structure so they can be closed to cover the unit space when the units have been temporarily removed. Unit doors shall be held closed with captive type screws, which engage self-aligning cage nuts. These screws shall provide at least 2 threads of engagement to help hold unit doors closed under fault conditions.

Removable door panels held captive type screws shall be provided on starter unit doors for mounting push buttons, selector switches or pilot lights. Blank door panels capable of accepting future push button devices shall be furnished when push button devices are not originally specified for starter units. Starter units shall have an external low profile overload reset button.

2. Pilot devices and instruments, including push buttons, reset buttons, and indicating lights, shall be flush mounted in the compartment doors. Equipment shall not be mounted on the rear of draw out units. All equipment within the unit shall be arranged to provide ample electrical clearances and easy access for maintenance. Draw out combination starter unit of a given type and size shall be made interchangeable. Only those items, which are common to all starters, shall be mounted in the unit.

3. Where a spare unit is indicated on the Drawings, it shall be a complete combination starter of the type and size shown.

M. Unit Support Pan:

1. Each plug-in unit shall be supported and guided by a tilt and lift-out removable pan so unit rearrangement is easily accomplished. For easy unit installation and rearrangement, transfer of this unit support pan from one location to another shall be accomplished without the use of tools after the unit and door have been removed.

N. Unit Saddles:

1. Each plug-in unit shall have a sheet steel saddle designed to physically isolate the unit from the bus compartment and adjacent units. Saddles shall be equipped with captive, self-aligning mounting screws, which hold the unit securely in place during shipment and maintain the unit and structure at the same potential. Handholds shall be provided on each plug-in unit to facilitate unit removal.

O. Disconnect Operator:

1. A flange mounted operator handle shall be supplied for each switch or breaker. To prevent false circuit indication, this mechanism shall be engaged with the switch or breaker at all times regardless of unit door position. The operator handle shall have a conventional up-down motion with the down position as "OFF." It shall be possible to lock this handle in the "OFF" position with up to three 3/8" diameter shackle padlocks. The operator handle shall be color coded to display red in the "ON" position and black in the "OFF" position.

2. The operator handle shall be interlocked with the unit door so the disconnect cannot be switched to the "ON" position unless the unit door is closed. It shall be possible to defeat this interlock by a deliberate act of an electrician should he desire to observe the operation of the operator handle assembly. This interlock shall also prevent opening the unit door, unless the disconnect is in the "OFF" position. A defeater for this action shall also be provided in the event an electrician must gain access to the unit without interrupting the service.

P. Starter Units:

1. Starter units shall be completely draw out Type B, sizes as indicated on the Drawings, so units may be withdrawn without disconnecting any wiring. Units over three space units high may be bolt-in type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in dead-front openings in vertical power bus. The screw racking mechanism shall serve as a mechanical advantage to the operator during unit insertion or removal. Stab-in power terminals shall be of a type that will increase contact pressure on short circuits.

2. All starter units shall be rated to withstand short circuits of 65,000 rms symmetrical amperes at 480 volts or as noted on the Drawings.

Q. Thermal Magnetic Type Circuit Breakers:

1. Thermal magnetic circuit breakers shall have quick-make, quick-break mechanisms and shall visually indicate whether the breaker is closed, open or tripped.

2. All breakers shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 480 volts.

R. Motor Circuit Protector Type Circuit Breakers:

1. Motor circuit protector type circuit breakers shall be used for all branch circuit breakers for motor circuits. Breakers shall be instantaneous trip, magnetic only type. Each breaker shall be furnished with a single magnetic trip adjustment, which simultaneously sets the magnetic trip level of all poles. Adjustment shall be continuous throughout the trip range. Minimum interrupting capacity of breakers shall be 65,000 amps rms symmetrical at 480 volts.

S. AC Magnetic Starters - Line Voltage Type:

1. Motor starters shall be across-the-line magnetic type, rated in accordance with NEMA standards, sizes and horsepower ratings. Starter sizes shall be as indicated on the Drawings.

2. Across-the-line magnetic starters shall be equipped with double-break, silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel.

3. Coils shall be of molded construction and shall operate on 120 volts AC. All coils shall be replaceable from the front without removing the starter from the panel.

4. Overload relays shall be solid state electronic type.

T. Electrical Interlocks:

1. All starters shall be furnished with electrical interlocks as shown on the Drawings plus one spare normally open and one spare normally closed contact. Arrangements shall be convertible from normally open to normally closed.

U. Control Transformers:

1. Provide a control transformer for each motor starter control circuit as indicated on the Drawings. Control transformers for individual control circuits shall be 480 volts to 120 volts and shall be protected according to code. Size shall be as required plus 50VA spare capacity. Primary fuses shall be Class "CC".

V. AC Magnetic Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the MCC cubicle. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Allen-Bradley or Square D.

W. Mixer Supervision Relays:

1. Install mixer supervision relays in the MCC where indicated on the Drawings. The relays shall be utilized to monitor a seal leak and motor overtemperature condition for the submersible mixers.

2. The supervision relays shall be furnished by the mixer manufacturer, for installation in the MCC.

X. Pump Monitoring Relays:

1. Install pump monitoring relays in the MCC where indicated on the Drawings. The relays shall be utilized to monitor a seal leak and motor overtemperature condition for the submersible pumps.

2. The monitoring relays shall be furnished by the pump manufacturer, for installation in the MCC.

Y. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on Drawings.

2. Provide auxiliary contact blocks as indicated on the Drawings, or in the Description of Operation.

Z. Push Buttons:

1. Push buttons shall be non-illuminated. They shall be 30.5 mm, heavy-duty, oil tight. Contacts rated for 10 amps minimum. Push buttons shall be momentary contact type unless noted otherwise on the Drawings.

AA. Pilot Lights:

1. Pilot lights shall be LED, push to test, transformer type. They shall be 30.5 mm, heavy-duty, oil tight. Voltage rating shall be 120 volts. Color caps shall be green for "run", and red for "alarm".

BB. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts.

2. Elapsed time meters shall be ENM Company Series T50, or equal.

CC. Legend Plates:

1. Provide an engraved legend plate for each pilot device. Engraving shall be as indicated on the Drawings.

DD. Identification:

1. A control center identification number nameplate describing section catalog numbers and characteristics shall be fastened on the vertical wire trough door of every section. Each control center unit shall have its own identification number nameplate giving unit catalog number fastened to the unit saddle near the upper left-hand corner. These nameplates shall also have suitable references to factory records for efficient communication with supplier.

2. Each control center unit shall also have an engraved Bakelite nameplate fastened to the outside of each unit door. Nameplates shall be black with white engraving.

EE. Wiring:

1. The motor control center shall be wired in accordance with NEMA class and type previously specified and shall be furnished to be interconnected with a programmable controller system.

2. All 120 VAC control wiring shall be red. Wiring for 24vdc PLC inputs shall be blue. All wiring in each MCC cubicle shall be labeled.

3. Quick separating, pull apart terminals shall be mounted on lift-out brackets in the units. All terminals shall be labeled.

FF. Finish:

1. All painted parts shall undergo a phosphatizing prepainting treatment for rust resistance and good paint bond. All painting shall be with enamel, which shall be baked for a durable, hard finish. Unit saddles shall be painted white for easy interior visibility. Removable push button plates, flange mounted operator handles and trim plates, and top horizontal wire trough cover plates shall be painted a contrasting charcoal gray. Other painted parts shall be painted ANSI-49 medium light gray.

2. All unpainted parts shall be plated for resistance to corrosion.

## 2.2 SPARE PARTS

A. Provide the following spare parts for the motor control center:

1. Six (6) Fuses for each type and size utilized

2. Two (2) Relays for each type utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

# PART 3 EXECUTION

## 3.1 FIELD SERVICES

A. Start-up and Testing:

1. Set up and provide all programming required for each power monitor.

2. Test the operation of each motor starter and all MCC controls.

3. Test the operation of the power failure and SPD alarm contacts.

4. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide two (2) hours of training on the motor control center. Training shall include theory of operation, maintenance and troubleshooting procedures.

**END OF SECTION 25 50 10**

# SECTION 25 50 11

# VARIABLE FREQUENCY DRIVES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish and install variable frequency AC drives as shown on the Drawings and specified herein.

2. The variable frequency drives shall be mounted in the motor control center, or shall be free-standing drives, as shown on the Drawings.

B. Special Requirements:

1. The variable frequency drives shall be furnished by the Process Control System Supplier, who shall be responsible for coordinating the drive start/stop and speed controls.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters Laboratories, Inc. |

1. The drives shall be built to applicable NEMA standards and be suitable for use as a component to meet NEC requirements. Drives shall be listed by Underwriters Laboratories (UL).

B. Quality Control:

1. All variable frequency drives shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

2. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications. All chips (CMOS, TTL, LINEAR, etc.) shall be functionally tested.

3. All subassemblies shall be inspected and/or tested for conformance to vendor's engineering and quality assurance specifications.

4. All drives shall be burned-in at the factory, cycling load to simulate no load/full load and exercise drive power components.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity,

ratings, integral controls, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Variable Frequency Drives
b. Drive Enclosure
c. Drive Disconnect Switch
d. Line Reactors
e. Control Transformers
f. Selector Switches
g. Pilot Lights
h. Elapsed Time Meters
i. Relays
j. Panel Layout Drawings
k. Wiring Diagrams

2. The panel layout drawings and VFD wiring diagrams shall be customized for this project. Standard drawings will not be accepted.

**1.4 MANUFACTURER**

A. The Variable Frequency Drives shall be Allen-Bradley PowerFlex 753.

**1.5 WARRANTY**

A. Provide a two (2) year warranty on each variable frequency drive. The warranty shall include parts and labor, and shall start on the date that the drive is started up by an authorized field service representative from the VFD manufacturer.

**PART 2 PRODUCTS**

**2.1 VARIABLE FREQUENCY DRIVES**

A. General:

1. The variable frequency drives shall convert a fixed frequency, three phase input power to an adjustable AC frequency and voltage source for controlling the speed of a standard, NEMA Design B, AC induction motor.

2. The drives shall be fully digital, microprocessor controlled and shall incorporate a diode bridge rectifier and a transistorized inverter section. IGBT type power transistor modules shall be utilized in the inverter section to invert a fixed DC bus voltage to a symmetrical three-phase pulse-width modulated (PWM) output voltage.

3. The drives shall accept incoming 480 VAC, 60 Hz line power, and shall not be affected by voltage fluctuations of ±10% or frequency fluctuations of ±2%. The drive shall include phase-to-phase and phase-to-ground protection, and transient voltage surge protection.

4. Each variable frequency drive shall be designed to operate a 460 volt, 3 phase AC induction motor in an ambient temperature of 32 to 104°F. The drive output amp rating shall exceed the motor nameplate FLA rating. Refer to drawings for motor horsepower and specs for motor RPMs.

B. Drive Enclosure:

1. The variable frequency drives shall be mounted in motor control centers, or in free-standing enclosures as shown on the Drawings. Provide ventilation fans and louvers as required to dissipate the heat generated by the drive.

C. Drive Operating Characteristics:

1. The drive operation shall be fully digital with microprocessor control of frequency, voltage and current. All drive set-up operations and adjustment shall be digital and stored in a non-volatile memory (EEPROM).

2. To control the rate of change of output frequency for a step change in input reference, the drive shall have two independently adjustable acceleration and deceleration rates.

3. The drive shall have a foldback current limiting circuit. During acceleration, the circuit shall automatically reduce the acceleration rate to a slower rate should the load inertia cause excessive currents.

4. The drive shall have a selectable deceleration voltage limiting circuit. The circuit shall extend the set deceleration ramp should the bus voltage approach high limits due to regeneration.

5. The drive output frequency shall be adjustable from 0-60 Hz.

6. The drive shall have a fully programmable volts per hertz ratio.

7. The drive shall maintain set frequency to within 0.6 Hz during power line fluctuations.

8. The drive speed reference signal shall be a 4-20mA analog output from the PLC, or a signal received from the VFD keypad module.

9. The drive shall be capable of maintaining 100% of rated output current continuously, and shall be capable of delivering 110% of rated output current for up to one minute.

10. The drive shall be capable of restoring motor operation after a 0.5 second line loss without shutting down on a fault.

11. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line.

12. The drive shall present a displacement power factor of 0.95 or better to the AC line at any speed or load.

13. The drive efficiency at rated load and frequency shall be 96% or better.

D. Drive Controls:

1. Each variable frequency drive shall be furnished with start/stop controls and speed controls as indicated on the Drawings and in the Description of Operation.

E. VFD Keypad Module:

1. A keypad module shall be mounted on the MCC or enclosure door for digital set-up of the drive, drive parameter review and drive fault annunciation. The module shall have an LCD display and a digital speed pot for local control of the drive speed.

F. Drive Protection and Diagnostics:

1. Each variable frequency drive shall incorporate internal diagnostic and fault sensing circuits as an integral part of the drive. The following drive protection functions shall be monitored:

a. Momentary Overload Protection - Adjustable from 20 to 115% of Drive Rating
b. Motor Overload Protection
c. Undervoltage Sensing
d. Overvoltage Sensing
e. Phase Protection
f. Drive Overtemperature
g. Ground Fault Detection

2. Each of the above fault conditions shall be annunciated on the digital display panel, and shall shut down the drive.

## 2.2 DRIVE CONTROL COMPONENTS

A. Line Reactors:

1. Provide line reactors for each VFD to eliminate nuisance overvoltage tripping and to reduce harmonic distortion. The line reactors shall be iron core, 5% impedance, Class H insulation, 115ºC rise, copper wound. The line reactors shall be sized for the motor horsepower and shall be manufactured by TCI.

B. Control Transformers:

1. Provide a control power transformer for each drive control circuit. Control transformers shall be 480 volts to 120 volts and shall be protected with primary and secondary fuses.

C. Selector Switches:

1. Selector switches shall be non-illuminated. Switches shall be 30.5 mm, heavy-duty, oil tight. Switches shall have double-break silver contacts. All switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks as indicated on the Drawings or in the Description of Operation. Provide a legend plate for each switch with white engraving as indicated on the Drawings.

2. Selector switches shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13.

D. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Color cap shall be green for "run" and red for “VFD fault". Provide a legend plate for each pilot light with white engraving as indicated on the Drawings.

2. Pilot lights shall be Allen-Bradley Bulletin 800T, NEMA Type 4/13.

E. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the drive enclosure. Contact configuration shall be 3PDT. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized.

F. Elapsed Time Meters:

1. Elapsed time meters shall be time totalizer, non-resettable. They shall have a synchronous motor, which shall drive a set of digit readout wheels to indicate the total time the unit is energized. Readout shall be five-digit including 1/10 digit. Range shall be 0 to 9999.9 hours. Voltage rating shall be 120 volts.

2. Elapsed time meters shall be ENM Company Series T50, or equal.

G. Control Wiring:

1. All 120 VAC control wiring shall be red. All 24vdc control wiring, and wiring for 24vdc PLC inputs, shall be blue. All wiring in the VFD shall be labeled.

H. Control Terminal Block:

1. Provide a control terminal block in the MCC bucket, or VFD enclosure, to terminate all control wiring from the field. All terminals shall be labeled with machine printed labels.

## 2.3 SPARE PARTS

A. Provide the following spare parts for the variable frequency drives provided:

1. One (1) spare VFD for each size provided.

2. Four (4) ventilation fans for each size utilized.

3. Four (4) sets of fan filters for each size utilized

4. Six (6) Fuses for each size and type utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part number.

# PART 3 EXECUTION

## 3.1 FIELD SERVICES

A. Start-up and Testing:

1. Provide the services of a manufacturer's representative to start-up, adjust and test each variable frequency drive. Demonstrate start/stop control, fault diagnostics and variation of motor speeds in response to both the manual and automatic variable speed controls.

2. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide four (4) hours of on-site training for the plant operators on the variable frequency drives. Training shall be specific for the VFDs provided and shall include theory of operation, maintenance and troubleshooting procedures. All training shall be performed by a qualified training specialist from the VFD manufacturer.

**END OF SECTION 25 50 11**

# SECTION 25 50 20

# CONTROL PANELS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish and install control panels for the Process Control System as indicated on the Drawings.

2. The control panels shall be provided by the Process Control System Supplier and shall be complete and include all components and wiring as shown on the Drawings and specified herein.

### 1.2 QUALITY ASSURANCE

A. Regulations and Standards:

| | |
|---|---|
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronic Engineers |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories |

B. The control panel components shall be of the most current 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 control panels. The components provided by the System Supplier shall be compatible with the functions required and shall form a complete working system.

C. Each control panel shall be UL listed as a complete assembly in accordance with UL-508.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on the control panel in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, wiring diagrams, and panel layout drawings showing dimensions to all devices.

## PART 2 PRODUCTS

### 2.1 CONTROL PANEL COMPONENTS

A. Control Panel Enclosure:

1. The control panel enclosure shall be designed and sized in accordance with the requirements of the Drawings and as specified herein. Control panel enclosures shall be manufactured by Hoffman or Saginaw.

2. Fiberglass control panel enclosures shall be NEMA Type 4X.

3. Wall-mounted stainless steel control panel enclosures shall be NEMA Type 4X, constructed of 14 gauge, Type 316 stainless steel.

4. Steel control panel enclosures shall be NEMA 12, constructed of 10 gauge steel with continuously welded seams. Panel shall have piano type hinged, overlapping doors with neoprene gasket. Enclosure doors shall be equipped with a heavy-duty 3-point latching mechanism operated by a padlocking handle. Following fabrication, the control panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted inside and out with an industrial grade enamel. The inside of the control panel shall be painted white. The exterior color shall be gray.

5. The control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted to a subpanel. All wiring shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically using Panduit to provide a neat appearance. The minimum width of the Panduit for field wiring shall be 4". All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. Terminals and wires shall be identified in accordance with the Supplier's panel wiring diagrams.

6. Provide a copper grounding plate inside each control panel for terminating all ground wires.

7. Provide a plastic data pocket in each free-standing control panel.

B. Enclosure Light Fixtures:

1. Provide a LED light fixture in control panels where indicated on the Drawings to illuminate the enclosure. The light fixture shall have a low profile design with a non-yellowing lens cover and a door-activated switch. The light fixture shall be Hoffman.

C. Control Circuit Breakers:

1. Control circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified. Circuit breakers shall be Allen-Bradley Bulletin 1492-CB, or equal.

D. Transient Voltage Surge Suppressor:

1. Provide a 120 volt, 1 phase transient voltage surge suppressor in the PLC Panels to protect the panel components from damage which may occur from transient overvoltages caused by lightning or surges on the incoming power line.

2. The surge suppressor shall use high speed silicon avalanche diodes as the suppression devices and shall have an indication light to indicate if the unit has failed.

3. Surge suppressor shall be Citel or Phoenix Contact.

E. Uninterruptible Power Supplies (UPS):

1. Provide a UPS in control panels where indicated on the Drawings to power the equipment in the panel. The UPS shall provide lightning and surge protection, spike attenuation, galvanic isolation, noise isolation, and a regulated 120 volt, 1-phase power supply. The power output shall be continuous with no interruptions.

2. The UPS shall be sized by the System Supplier based on the maximum power requirements of the control panel and for a minimum run time of 10 minutes. The UPS shall be furnished with two (2) alarm contacts to indicate when the UPS is operating on battery power and when the UPS battery needs replaced.

3. The UPS shall be APC, or equal.

F. 24 Volt DC Power Supplies:

1. 24 volt DC power supplies shall be mounted in control panels, where indicated on the Drawings, to supply 24 volt DC power for the 24 volt DC programmable controller inputs and for the 2-wire instrumentation. Provide a redundancy module for each pair of power supplies. The power supplies shall be sized as required.

2. 24 volt DC power supplies shall be Allen-Bradley Bulletin 1606, or equal by Phoenix Contact.

G. Selector Switches:

1. Selector switches shall be 30.5mm, heavy-duty, non-illuminated. Switches shall have double-break silver contacts. Switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks on switches where indicated on the Drawings or in the Description of Operation. Provide a gray legend plate for each switch with white engraving as indicated on the Drawings.

2. Selector switches shall be Allen-Bradley Bulletin 800H, NEMA Type 4X.

H. Push Buttons:

1. Push buttons shall be 30.5mm, heavy-duty, non-illuminated. Push buttons shall have double-break silver contacts. Push buttons shall be momentary contact type and shall be color-coded as indicated on the Drawings. Stop push buttons shall have extended heads. All other push buttons shall have flush heads. Provide a gray legend plate for each push button with white engraving as indicated on the Drawings.

2. Push buttons shall be Allen-Bradley Bulletin 800H, NEMA Type 4X.

I. Pilot Lights:

1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Lens color shall be as indicated on the Drawings. Provide a gray legend plate for each pilot light with white engraving as indicated on the Drawings.

2. Pilot lights shall be Allen-Bradley Bulletin 800H, NEMA Type 4X.

J. Relays:

1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the panel enclosure. Terminals for relays having AC coils shall be pin type, and terminals for relays having DC coils shall be blade type. Contact configuration shall be 3PDT.

2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Idec RR Series, or equal.

K. Digital Process Meters:

1. Digital process meters shall be flush mounted in control panels where indicated on the Drawings. The meters shall receive 4-20mA process input signal and shall digitally display the process variable in engineering units. The process meters shall operate on 120 volt AC power and shall have an accuracy of ±0.05% of the reading.

2. The digital process meters shall be Precision Digital Trident Model PD765.

L. TVSS Devices for Analog Signal Wiring:

1. Provide a transient voltage surge suppressor (TVSS) on all analog signal wiring that originates from outside of a building to protect the analog signal wiring from surges and transient voltages. The TVSS device shall have of a pluggable surge protection module, and shall be furnished with a status indicator for visual indication that the unit is functioning.

2. The TVSS devices shall be Phoenix Contact PLUGTRAB PT for analog signal wiring.

M. Fuses:

1. All fuses shall be sized as required for the circuit they are protecting. Fuses shall be Ferraz Shawmut, touch-safe type, or equal.

N. Terminal Blocks:

1. Terminal blocks shall be provided in each control panel for terminating field wiring. All terminal blocks shall be rated for 600 volts AC, and shall be identified with a permanent machine printed marking in accordance with the terminal numbers shown on the panel wiring diagrams.

2. Terminal blocks for the PLC I/O wiring in PLC Panels shall be grouped and labeled by the I/O card. Labels for each group of terminal blocks shall be DI-X, DO-X, AI-X or AO-X, where “X” is the module number – 1, 2, 3, etc.

3. All terminal blocks shall be single level type.

4. Terminal blocks for 24vdc inputs shall be blue.

5. Provide 20% spare terminal blocks in each control panel.

6. Terminal blocks shall be Allen-Bradley Bulletin 1492-W4, or equal.

O. Wiring:

1. All wiring shall be stranded copper. Control wiring shall be 16 gauge, 600 volt, Type MTW. Power wiring shall be 600 volt, Type MTW, sized as required.

2. All analog signal wiring shall be 18 gauge twisted pairs with foil shield and drain wire, with 300 volt, 90°C insulation. Drain wires shall be grounded at one end only.

3. All wiring and terminal strips shall be isolated by voltage levels to the greatest extent possible.

4. All wiring shall conform to the following color code:

120 volt, 1 phase: Black, White

24vdc: Blue

120 VAC Control Wires: Red

Intrinsically Safe Wiring: Purple

Ground Wires: Green

5. 120 VAC control wires energized from a source external to the control panel power source shall be yellow.

6. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams, and shall match terminal strip numbers.

P. Nameplates:

1. Provide laminated phenolic nameplates on the front of each control panel. Nameplates shall be black with white engraved letters. Engraving shall be as indicated on the Drawings. Minimum size of engraving shall be 1/4".

**2.2 SPARE PARTS**

A. Provide the following spare parts for the control panels:

1. Two (2) 24 volt DC power supplies for each size utilized

2. Two (2) general purpose relays for each type utilized

3. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

**PART 3 EXECUTION**

**3.1 FIELD SERVICES**

A. Start-up and Testing:

1. Test the operation of each control panel and all controls.

2. Start-up each control panel and place the control panel into operation.

3. All start-up and testing shall be performed in the presence of the Owner and the Engineer.

B. Training:

1. Provide eight (8) hours of on-site training for the plant operators on the control panels. Training shall be specific for the control panels provided and shall include theory of operation, maintenance and troubleshooting procedures.

**END OF SECTION 25 50 20**

# SECTION 25 50 30

# INSTRUMENTATION

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Work Included:

1. Furnish and install all instrumentation and provide services as specified herein or as indicated on the Drawings. Instrumentation shall be provided by the Process Control System Supplier.

### 1.2 QUALITY ASSURANCE

A. Regulations and Standards:

| | |
|---|---|
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronic Engineers |
| ISA | International Society of Automation |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories |

B. All instrumentation equipment supplied shall be of the most current 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 instrumentation equipment. The equipment provided by the System Supplier shall be compatible with the functions required for the Process Control System.

C. All necessary fuses and cables required for instrumentation equipment shall be provided with the equipment.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on all instrumentation in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Submittals shall include a complete bill of material, catalog information, descriptive literature of all components and wiring diagrams.

## PART 2 PRODUCTS

### 2.1 INSTRUMENTATION

A. Magnetic Flow Meters:

1. Magnetic flow meters shall be of the low frequency and short form characterized coil design. The characterized field principle of electro-magnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the flow rate.

2. The metering tube shall be constructed of Type 304 stainless steel. The meter body shall be carbon steel. The flow meter shall have a flanged body to fit between ANSI Class 150 pipe flanges. The flow meter shall have a polyurethane liner and Type 316 stainless steel electrodes. The

electrodes shall be bullet nose type. Liners and electrodes shall be suitable for municipal sewage and sludge. Provide all required mounting hardware, stainless steel grounding rings and grounding straps for the installation of the magnetic flow meter.

3. The coils, which generate the field, shall be inside the pipe wall and shall be encapsulated in epoxy resin and encased behind the meter lining material. The ratio of flow velocity to reference voltage signals generated shall be compatible with the readout instrument without the necessity of circuit modifications. The meter shall have an average power consumption of 60 watts. Accuracy of the meter shall be ±2 percent of rate.

4. The meter housing shall be splash-proof and weather resistant design. The meter shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics.

5. Complete zero stability shall be inherent characteristic of the meter system. This shall eliminate the requirement for valving downstream of the meter for creating a full pipe zero flow condition for calibration purposes. Meter systems requiring field zero adjustment will not be acceptable.

6. The magnetic flow meters shall be factory calibrated on an approved test stand with certified accuracy traceable to NIST, compliant with the ISO 17025 standard, and third party accreditation by a national verification agency such as A2LA. Calibration curves shall be submitted for each flow meter for 3 points within the specified flow range.

7. The flow meter shall have a remote mounted microprocessor based, NEMA 4X flow transmitter. The flow transmitter shall have an LCD display to indicate the flow rate. The flow transmitter shall convert the meter's DC pulsed signal to a linear 4-20 mA dc signal which is proportional to the flow rate.

8. The flow meter transmitter shall operate on a 120VAC, 60 Hz power source and shall have RFI protection. Provide a signal cable to connect the flow transmitter to the flow meter. Length of cable shall be as required for the installation (See Electrical Drawings).

9. The Magnetic Flow Meters shall be Endress & Hauser Promag 400W, or Rosemount Model 8071.

SCHEDULE OF MAGNETIC FLOW METERS

| Size | Flow Range | Service |
|---|---|---|
| 3” | 0 – 100 GPM | Utility Water Flow |
| 6” | 0 – 0.5 MGD | EQ Return Flow |
| 8” | 0 – 1.0 MGD | SBR Influent Flow |
| 8” | 0 – 1.0 MGD | Post EQ Pump Discharge Flow |

B. Pressure Transmitters:

1. The pressure transmitters shall be a single chamber piezoresistive type electronic transmitter, which shall produce a linear current output signal proportional to the gage pressure.

2. The process connection shall be 1/4” NPT female. The process connection and isolating diaphragm shall be 316L stainless steel. The process fill fluid shall be silicone oil.

3. The transmitter shall have a continuous 100 to 1 span adjustment. Reference accuracy shall be ±0.065% of span.

4. Zero and span adjustment shall be electronic by means of zero and span buttons.

5. Process temperature limits shall be -40 to +250°F. The temperature limits for the electronics shall be -4 to +175°F. Humidity limits shall be 0-100% relative humidity.

6. The transmitter shall be a true 2-wire device with 24 volt DC power being derived from the control panel power supply. The electronic unit shall be of modular plug in design utilizing integrated circuitry. The transmitter output shall be a linear 4-20mA dc signal.

7. The range of the pressure transmitter shall be as indicated on the schedule below.

8. The transmitter electronics housing shall be constructed of die cast aluminum with a polyurethane coating. The transmitter housing shall meet NEMA 4X requirements. The electrical connection shall be a 1/2" NPT conduit thread.

9. The transmitter shall be furnished with a mounting bracket and stainless steel bolts suitable for wall mounting the transmitter.

10. Provide a calibration data sheet for each pressure transmitter.

11. The pressure transmitters shall be Rosemount Model 2051, or Endress & Hauser Cerabar S PMC71.

SCHEDULE OF PRESSURE TRANSMITTERS

| Location | Range | Service |
|---|---|---|
| Utility Water Valve Vault | 0 – 100 psi | Utility Water Pressure |

C. Radar Level Transmitters:

1. The radar level transmitter shall reliably and accurately sense the liquid level in a covered or open tank.

2. The level transmitter shall be a true 2-wire device with 24 volt DC power being derived from the control panel power supply. The electronic unit shall be of modular plug in design utilizing integrated circuitry. The transmitter output shall be a linear 4-20mA dc signal.

3. The level transmitter shall be a pulsed time of flight radar transmitter which shall operate at 26 GHz using 2-wire technology for level measurement and provide a 4-20 mA HART output.

4. The transmitter housing shall have dual compartments and shall be die cast aluminum with a powder Epoxy coating.

5. The transmitter shall employ multi echo tracking algorithms for reliable level measurement.

6. The unit shall not be affected by changing media, changing temperatures, gas blankets or vapors. The transmitter shall measure almost completely independent from product properties.

7. The transmitter shall contain a gas tight feed through to prevent process from intruding into the housing from the process vessel when required.

8. The transmitter shall have a 4 line LCD display. All programming and set-up shall be done by the three buttons on the display. The unit shall have the capability of mapping out any object that causes an interference the in the radar reflections.

9. FDT based software shall be provided for optional remote method of configuration, set-up and storage of parameters via a computer.

10. The display module shall be capable of data backup, data comparison and data transfer functions. It shall be possible to view a graphical representation of the actual signal and envelope curve on the display.

11. The transmitter will have a 32 point linearizer to correct output to represent volume measurement or use as a strapping table for level correction.

12. The unit shall have a measuring range up to 30 feet.

13. The unit shall be suitable for process temperatures up to 100º F.

14. The transmitter shall have a built-in HistoRom which will store the configuration data and be capable of logging 20 events based on programmed triggers.

15. The level transmitter shall have a 4" mounting flange for flange mounting the transmitter on top of the tank.

16. The radar level transmitters shall be Endress & Hauser Micropilot M FMR 51, or equal by Vega.

SCHEDULE OF RADAR LEVEL TRANSMITTERS

| Location | Service |
|---|---|
| Influent EQ Tank | Influent EQ Tank Level |
| Post EQ Tank | Post EQ Tank Level |
| Alum Storage Tank | Alum Storage Tank Level |
| Micro-C Storage Tank | Micro-C Storage Tank Level |
| Waste Biosolids Tank | Waste Biosolids Tank Level |

D. Float Switches:

1. Each float switch shall consist of a single pole, mechanical switch in a smooth, chemical resistant polypropylene casing with integral 2-wire cable. The mercury switch shall be permanently molded to the signal cable at the factory. Flooding float switches shall be normally closed, and all other float switches shall be normally open.

2. Signal cable shall be minimum #18 AWG. Length of cable shall be as indicated on schedule below.

3. Specific gravity of sensors shall be 0.95-1.10. Sensors shall remain operable at temperature down to 0°C and up to 90°C. Switch contacts shall operate on 24 volts DC or 120 volts AC.

4. Provide a 316 stainless steel mounting bracket for each float switch.

5. The float switches shall be Anchor Scientific Roto-Float, or equal.

SCHEDULE OF FLOAT SWITCHES

| Qty. | Type | Cable Length | Mounting Bracket | Service |
|---|---|---|---|---|
| 1 | S | 20 Feet | WMS | EQ Return Flow Control Vault Flooding |
| 1 | S | 20 Feet | WMS | EQ Return Flow Control Vault Flooding |
| 1 | S | 20 Feet | WMS | Utility Water Valve Vault Flooding |

**2.2 INSTRUMENT NAMEPLATES**

A. Provide a laminated phenolic nameplate for each instrument. The nameplates shall be black with white engraved letters, and they shall be mounted on the front of each instrument or instrument enclosure, or where applicable attached to the instrument with a plastic wire tie. An instrument nameplate schedule shall be submitted to the Engineer for approval prior to performing any engraving.

**2.3 SPARE PARTS**

A. Provide the following spare parts for the instrumentation:

1. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

**PART 3 EXECUTION**

**3.1 INSTALLATION ASSISTANCE AND INSPECTION**

A. Provide the services of manufacturer’s service representatives to assist in installation for all instrumentation specified herein.

B. Each manufacturer’s representative shall inspect the installation of each of his instruments, and shall issue an installation certificate to the Owner and the Engineer for each instrument certifying that the instrument has been installed in accordance with the manufacturer’s recommendations.

**3.2 CALIBRATION**

A. Provide the services of manufacturer's service representatives to calibrate all instrumentation provided. All calibration shall be performed in the presence of the Owner and the Engineer. The calibration of each instrument shall be performed after the instrument installation certificate has been issued.

B. Each manufacturer's representative shall issue a calibration certificate to the Owner and the Engineer for each instrument certifying that the instrument has been calibrated and is ready to be placed into service. The calibration certificates shall indicate the calibrated range or setpoint for each instrument.

**3.3 TRAINING**

A. Provide four (4) hours of training on the instrumentation provided.

B. All training shall be performed by a representative from the manufacturer and shall be specific to the instruments provided. Training shall include theory of operation, maintenance requirements, calibration methods and function of instrument in the Process Control System.

**END OF SECTION 25 50 30**

# SECTION 25 50 40

# PROGRAMMABLE CONTROLLER SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish all labor and materials required for a complete programmable controller system consisting of programmable controllers, I/O modules, operator interface terminals, industrial Ethernet switches, power supplies, power and communication cables, software packages, and all other associated equipment as specified herein and as indicated on the Drawings.

B. System Configuration:

1. The system shall be configured as shown on the Process Control System Drawings and as described in the Description of Operation.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronic Engineers |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |

B. Quality Control:

1. All equipment and software supplied shall be of the most current and proven design. The Specifications and Drawings call attention to certain features but do not purport to cover all details entering into the design of the programmable controller system. The completed system and the equipment provided shall be compatible with the functions required and shall be a complete working system.

C. Manufacturer:

1. The programmable controller system shall be manufactured by Allen-Bradley. All model numbers shown on the Drawings are Allen-Bradley numbers.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on each of the items listed below in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects, and shall include a complete bill of material, catalog information, descriptive literature of all components, and applicable wiring diagrams.

a. Programmable Controllers
b. Programmable Controller Power Supplies
c. Input and Output Modules

d. Operator Interface Terminals
e. Ethernet Switches
f. Power and Communication Cables
g. Programming Software

**1.4 MEETINGS**

A. Initial Coordination Meeting:

1. The System Supplier shall attend and participate in an initial meeting with the Engineer and the Owner to discuss the PLC control logic, and the layout, color conventions, and control strategies for the operator interface screens. This meeting will be held at the Smithsburg WWTP.

B. Operator Interface Review Meetings:

1. The System Supplier shall attend and participate in a minimum of two (2) review meetings with the Owner and the Engineer to review the operator interface graphic screens. These meetings will be held at the Smithsburg WWTP.

**PART 2 PRODUCTS**

**2.1 SYSTEM HARDWARE**

A. Programmable Controllers:

1. Provide an Allen-Bradley CompactLogix 5069-L330ER programmable controller in PLC Panels as indicated on the Drawings. The programmable controller shall be mounted with input and output (I/O) modules as indicated on the Drawings.

2. The programmable controller shall be furnished with an Allen-Bradley flash memory card. The PLC program shall be stored on the flash memory card.

B. Programmable Controller Power Supplies:

1. Provide an Allen-Bradley power supply for each programmable controller as indicated on the Drawings. The power supply shall be sized as required for the power consumption of the system.

C. Operator Interface Terminals:

1. An operator interface terminal shall be flush mounted in PLC Panels where indicated on the Drawings to display process values, alarm messages and graphic displays, and to provide an interface for the operator to change process setpoints.

2. The operator interface shall have a TFT color touch screen with a NEMA 4X rating. Size shall be as indicated on the Drawings.

3. The operator interface shall be networked to the programmable controller via Ethernet. The operator interface shall be furnished with enough memory to meet the requirements of the Description of Operation plus 20 percent spare memory.

4. The operator interface shall operate on 120 VAC power.

5. The operator interface terminals shall be Allen-Bradley PanelView Plus 7 Performance Model.

6. The operator interface terminals shall be furnished with Factory Talk View Studio for Machine Edition and RSLinx software.

D. Ethernet Switches:

1. Provide a managed industrial Ethernet switch in control panels where indicated on the Drawings, to network the PLCs and operator interface terminals.

2. Each Ethernet switch shall be furnished with the number of copper and fiber ports required for the system. Provide a minimum of two (2) spare copper ports on each switch.

3. Each Ethernet switch shall be a stand-alone unit operating on 24vdc power.

4. The Ethernet switches shall be Antaira, Moxa, N-tron or Stratix.

E. Fiber Optic Patch Panels:

1. Provide fiber optic patch panels in control panels where indicated on the Drawings for terminating the 6-strand fiber optic cables.

## 2.2 COMMUNICATIONS CABLES

A. Ethernet Cable:

1. Provide Cat 6 Ethernet cable to network the PLCs and the operator interface terminals as shown on the Drawings. The System Supplier shall furnish all cables required for the Ethernet network. The Ethernet cables shall be blue.

B. Fiber Optic Cable:

1. Provide fiber optic cable to network the PLCs as shown on the Drawings.

2. The fiber optic cable shall be 6-strand 62.5/125 micron multi-mode, tight buffered, for outdoor service. The fiber optic cable shall be Optical Control Corporation Laser Ultra-Fox, BX-Series with an orange jacket, or equal.

3. The System Supplier shall test each fiber optic cable before and after all terminations are made. All testing shall be performed in the presence of the Owner and the Engineer. Any cables which do not pass the test shall be replaced in their entirety.

## 2.3 PROGRAMMING SOFTWARE

A. Programmable Controller Programming and Documentation Software:

1. Provide a windows based programming and documentation software package for programming the Allen-Bradley programmable controllers using a personal computer as a programming terminal. This software package shall be used to program the programmable controllers.

2. The programming and documentation software shall be latest version of Rockwell Software RSLogix 5000, Professional Edition.

3. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

B. Operator Interface Terminal Programming Software:

1. Provide a Windows based programming and development software package to program the operator interface terminals using a personal computer. This software package shall be used to program the operator interface terminals.

2. The programming and development software shall be the latest version of RSView Studio for Machine Edition.

3. The programming software, and all licenses, shall be turned over to the Owner at the completion of the project.

**2.4 SPARE PARTS**

A. Provide the following spare parts for the programmable controller system:

1. One (1) CompactLogix Programmable Controller

2. One (1) Programmable Controller Power Supply

3. Two (2) 24vdc Input Modules

4. Two (2) 24vdc Output Modules

5. One (1) Analog Input Module

6. One (1) Analog Output Module

7. One (1) Ethernet Switch

8. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

**PART 3 EXECUTION**

**3.1 SOFTWARE PROGRAMMING**

A. PLC Programming:

1. Program each PLC to meet the requirements of the Description of Operation.

2. All programming shall be annotated and documented with rung numbers, descriptive comments and I/O identification comments. The beginning of each major sub-system shall be identified in the PLC program.

3. Copies of the PLC programs shall be furnished to the Owner on CD, and on a hard copy print-out.

B. Operator Interface Programming:

1. General:

a. Program each operator interface terminal to meet the requirements of the Description of Operation. All programming and graphic screen development shall be performed as required for a complete and operational system.

2. Graphic Displays:

a. Dynamic graphic displays shall be programmed in the operator interface for the process equipment and its associated control strategies. The graphic displays shall be interactive with live data from the programmable controller.

b. The graphic displays shall include all digital and analog points being monitored by the PLC system.

c. The graphic displays shall indicate the auto/manual status, run status and alarms for all system equipment.

d. The graphic displays shall allow the operator to set and adjust all process setpoints, and timer settings for control of the system equipment.

e. The configuration of each graphic screen shall be reviewed with and approved by the Owner and the Engineer.

3. Alarms:

a. All alarms for the system shall be displayed on the alarm display screen on the operator interface.

4. Monitoring of Process Variables:

a. All process variables being monitored by the system shall be displayed by the operator interface.

**3.2 TESTING**

A. Field Testing:

1. Test the operation of each PLC I/O point after the PLC System is installed.

2. Analog points shall be tested using a signal generator. Each point shall be tested at 0, 25, 50, 75 and 100% of its full scale range.

3. Test the operation of each graphic screen programmed in the operator interface terminals to verify the digital and analog points display correctly on the screen.

4. Test all control strategies to verify that they function correctly.

5. Test all alarms in the system to verify that they display correctly.

6. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

**3.3 TRAINING**

A. On-Site Training:

1. Provide eight (8) hours of training for the Owner on the operation of the PLC System and the operator interface terminals. Training shall be conducted on two separate days with four (4) hours of training being performed each day. Training shall be conducted at the wastewater treatment plant.

**END OF SECTION 25 50 40**

# SECTION 25 50 42

# COMPUTER SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish a computer system consisting of a personal computer, a printer, and other associated hardware, including power and communication cables, software packages, programming, and all other associated equipment as specified herein and as indicated on the Drawings.

2. The personal computer will be utilized as the operator workstation for the Process Control System. The computer shall be networked to the PLC system via Ethernet.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

NEC National Electrical Code of National Fire Protection Association
UL Underwriters' Laboratories

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on the computer system in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects and shall include catalog information and descriptive literature of all components.

## PART 2 PRODUCTS

### 2.1 SYSTEM HARDWARE

A. Personal Computer and Printer:

1. Furnish one (1) personal computer complete with 30" widescreen flat panel monitor, keyboard, Ethernet card, modem, optical mouse, and UPS.

2. Furnish one (1) color laser printer for use with the computer. The printer shall be networked via Ethernet.

3. Due to the changing nature of the computer industry and in order to ensure that the Owner receives the most technologically advanced computer system available at the time of purchase, the System Supplier shall include in their bid a $5,000.00 monetary allowance for the computer system.

4. Coordinate the purchase of the computer system with the Engineer and the Owner.

**2.2 SYSTEM SOFTWARE**

A. Operating Software:

1. Provide the latest version of the following software packages on the computer:

   a. Microsoft Windows
   b. Microsoft Office Professional
   c. McAfee Virus Scan

2. The Windows software shall be the version recommended for use with the HMI software.

3. All software shall be furnished pre-installed on the hard drive with a master CD as back-up.

B. PLC Programming Software:

1. Install the PLC programming software on the personal computer.

C. HMI Software:

1. Install the HMI software on the personal computer.

**PART 3 EXECUTION**

**3.1 SOFTWARE PROGRAMMING**

A. Provide all software programming required to network the personal computer to the Ethernet network.

B. Provide all software programming required to utilize the personal computer as a programming terminal for the PLCs.

C. Provide all software programming required to interface the Windows operating system with the HMI software.

**END OF SECTION 25 50 42**

# SECTION 25 50 45

# HMI SOFTWARE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish, install and program a complete HMI software package for the Process Control System. The HMI software shall be installed on the operator workstation.

B. System Configuration:

1. The system shall be configured as shown on the Process Control System Drawings and as described in the Description of Operation.

C. Description of Operation:

1. The Description of Operation for this project is contained in Section 25 50 50. All system configuration and software programming shall be performed to meet the requirements of this description.

### 1.2 QUALITY ASSURANCE

A. Quality Control:

1. All software supplied shall be of the most current version. The Specifications and Drawings call attention to certain features but do not purport to cover all details of the software. The software provided shall be compatible with the functions required and shall be furnished with all optional packages required for a complete working system.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings on each of the items listed below in accordance with the requirements of Section 25 50 01. Shop drawings shall be complete in all respects, and shall include a complete bill of material, catalog information, and descriptive literature.

    a. HMI Software
    b. Reporting Software
    c. Alarm Notification Software
    d. Customized Graphic Screens
    e. Trend Displays

### 1.4 MEETINGS

A. Initial Meeting:

1. The System Supplier shall attend and participate in an initial meeting with the Engineer and the Owner to discuss the layout, color conventions, and control strategies for the HMI screens. The configuration of the process reports shall also be discussed at this meeting. This meeting will be held at the Smithsburg Wastewater Treatment Plant.

B. HMI Review Meetings:

1. The System Supplier shall attend and participate in a minimum of two (2) review meetings with the Engineer and the Owner to review the HMI screens and the process reports. These meetings will be held at the Smithsburg Wastewater Treatment Plant.

## PART 2 PRODUCTS

### 2.1 HMI SOFTWARE

A. General:

1. A windows-based Process Control Software package, hereafter referred to as the HMI software, shall be provided for the Process Control System. The HMI software shall run under the Windows 64-bit platform and shall be utilized as the operator interface to the PLC System. The software shall perform the following functions:

   a. Graphic Displays of the Process
   b. Event Logging and Printing
   c. Alarm Logging and Printing
   d. Real-Time and Historical Trends of Process Variables
   e. Generate Process Reports

2. The HMI software shall be furnished with communication drivers to operate with CompactLogix PLCs.

3. The HMI software shall be the latest version of Rockwell Software Factory Talk View SE.

4. The specific requirements for the system are as follows:

   a. Provide a development and runtime system for the Operator Workstation located in the Control Building. This workstation will function as the HMI server.

   b. Plant personnel shall be able to view the HMI software and make process changes on the operator workstation. The software shall have security levels and passwords that will allow the plant staff to make certain changes depending on their security level.

   c. Provide an Historian for logging and archiving historical data. The Historian shall be furnished with a minimum of 5,000 tags.

5. The HMI software shall include an optional software package to allow remote viewing and control of the HMI screens via an iPad.

### 2.2 REPORTING SOFTWARE

A. General:

1. Provide a windows-based reporting software package for generating customized Excel reports. The software package shall be installed on the Operator Workstation.

2. The reporting software shall be XLReporter by Sytech, Inc., or equal.

**2.3 ALARM NOTIFICATION SOFTWARE**

A. General:

1. Provide a windows-based alarm notification software package for remote notification of alarms via a modem. The software package shall be installed on the Operator Workstation.

2. The alarm notification software shall be TopView by Exele.

**PART 3 EXECUTION**

**3.1 SOFTWARE PROGRAMMING**

A. HMI Software Programming:

1. General:

a. Program the HMI Software to meet the requirements of the Description of Operation. All programming and graphic screen development shall be performed as required for a complete operational system.

b. All graphic displays programmed by Aqua-Aerobics in the operator interface on the SBR Control Panel shall be duplicated in the HMI software.

c. All graphic displays programmed by Evoqua in the operator interface on the Filter Control Panel shall be duplicated in the HMI software.

2. Graphic Displays:

a. Dynamic graphic displays shall be programmed in the HMI software for the treatment plant sub-systems and control strategies. The graphic displays shall be interactive with live data from the programmable controller.

b. A separate graphic display, or several displays as necessary, shall be developed by the System Supplier for each section of the Description of Operation. Where appropriate, certain sections of the Description may be combined in one display, as long as the display does not appear crowded. In addition, the following graphic displays shall be developed:

1) Plant Overview Graphic
2) PLC System Architecture
3) Five (5) additional graphic displays to be determined during the construction and start-up phases of the project

c. The graphic displays shall include all digital and analog points being monitored by the PLC system.

d. The graphic displays shall indicate the auto/manual status, run status and alarms for all process equipment.

e. The graphic displays shall allow the plant operator to set and adjust all analog setpoints, and timer settings for control of process equipment. The setpoint adjustments shall be capable of being made from the local operator interface terminal or the HMI software.

f. Navigation buttons shall be provided on each graphic display to allow the plant operator to easily navigate between screens.

g. The configuration of each graphic display shall be reviewed with and approved by the Owner and the Engineer.

3. Event Logging:

a. All events that occur for the treatment plant shall be displayed on the event display screen in the HMI software. The date and time each event occurs shall be displayed. The events shall include process changes made by the operators, and motors starting and stopping.

b. The software shall incorporate the ability to display, log and print all events.

c. All events shall be logged on the Historian.

4. Alarms:

a. All alarms for the treatment plant shall be displayed by the alarm historian and the alarm display screen in the HMI software. The date and time each alarm occurs shall be displayed.

b. The software shall incorporate the ability to annunciate, display, acknowledge and log all alarms.

c. All alarms shall be logged on the historian.

5. Run Time Monitoring:

a. The HMI software shall be programmed to monitor the run time of all motors being monitored by the PLC System.

b. Motor run time reports shall be created in the XLReporter software. These reports shall be automatically printed at the end of each month, and shall also be capable of being printed on demand.

6. Monitoring of Process Variables:

a. All process variables being monitored by the PLC System shall be displayed, trended and logged by the HMI software.

b. Real-time and historical trends shall be configured in the HMI software for each process variable.

c. All flows being monitored shall be totalized by the PLC System. Flow totals shall be daily totals, and shall also include the previous day's total flow. Flow totals shall be displayed by the HMI software.

d. All process variables shall be logged by the Historian.

B. Reporting Software Programming:

1. Reports:

a. Program the XLReporter software to generate customized Excel reports for the treatment plant. Daily and monthly reports shall be created for the process variables being monitored by the system. The daily reports shall include the minimum, maximum and average values for each hour of the day. Flows shall be integrated for each hour. The monthly reports shall include the minimum, maximum, average and totals for each day of the month. The reports shall be automatically printed at the end of each time period.

b. A total of ten (10) customized reports shall be developed for the system. The configuration of each report shall be determined by, and reviewed with, the Owner during the Construction Phase of the project. The reports shall be available on demand or printed out at the end of a time period as required by the Owner.

C. Alarm Notification Software Programming:

1. Reports:

a. Program the alarm notification software to provide remote alarm notification of all treatment plant alarms.

## 3.2 TESTING

A. General:

1. Test the HMI software by simulating each digital and analog PLC I/O point in the system to verify that the point displays correctly on the graphic screen.

2. Test all control strategies to verify that they function correctly.

3. Test all alarms in the system to verify that they display correctly.

4. Test all reports and verify that the information in the report is correct.

5. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

## 3.3 TRAINING

A. Software:

1. Provide eight (8) hours of training for the plant staff on the operation of the HMI software, reporting software and alarm notification software. Training shall be conducted on two separate days with four (4) hours of training performed each day. Training shall be conducted at the wastewater treatment plant.

**END OF SECTION 25 50 45**

# SECTION 26 00 00

# ELECTRICAL GENERAL REQUIREMENTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. All labor, materials, and equipment, not specified in detail or shown on drawings but necessary for the complete installation and proper operation of the work described or implied, shall be furnished and installed.

2. Test all electrical conductors, after completion of installation of wiring and apparatus, to insure continuity, proper splicing, freedom from grounds, except "made grounds" and those required for protection and insulation resistance. Use testing instruments, i.e. megger. Activation of each circuit will be required as final test. Testing shall be done at no additional expense to the Owner.

3. Drawings are indicative of work to be installed but do not indicate all bends, fittings, boxes, etc. that will be required in this Contract. The structural and finished conditions of the project shall be investigated prior to construction.

4. Coordinate work to avoid interferences between piping, ducts, equipment, architectural or structural features.

5. Visit the site to determine actual conditions. No extra compensation will be allowed by failure to determine existing conditions.

B. Additional Circuits:

1. A sum of money shall be included in the Base Bid for the Contract for ten (10) additional circuits. Each additional circuit shall include the following:

   a. 100’ of 3/4" rigid aluminum conduit and associated fasteners
   b. 300’ of #12 THHN/THWN wire, or 100’ of 1 Pr. #18 Shld. cable
   c. One (1) aluminum junction box
   d. 3’ of 3/4" flexible conduit
   e. Final wiring connections

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute, Inc. |
| ASTM | American Society for Testing and Materials |
| BOCA | Building Officials and Code Administrators |
| IEEE | Institute of Electrical and Electronic Engineers |
| ISA | International Society of Automation |
| IPCEA | Insulated Power Cable Engineers Association |
| NEC | National Electrical Code of National Fire Protection Association |
| NEMA | National Electrical Manufacturers Association |
| NESC | National Electrical Safety Code |

UL Underwriters' Laboratories

1. The installation must comply with all Federal and State, municipal or other authority's laws, rules and/or regulations.

2. Electrical inspections shall be made by the Middle Department Inspection Agency, or equal. The cost of the inspections shall be paid by the Contractor.

3. All electrical equipment and its components and materials shall meet all applicable UL criteria and bear the appropriate label of the Underwriters' Laboratory.

4. All electrical equipment or apparatus of any one system shall be of the same quality as produced by one or more manufacturers, suitable for use in a unified system. The term "manufacturer" shall be understood as applying to a reputable firm who assumes full responsibility for its products.

## 1.3 SUBMITTALS

A. Shop Drawings:

1. All shop drawings shall be submitted to the Engineer for review. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the shop drawings. If incorrect, they shall be resubmitted in quantity according to Contract conditions until satisfactory. Work shown on shop drawings shall not be executed until such drawings are approved. Electrical items shall not be installed until final approval of the shop drawings has been given by the Engineer.

2. See specific sections for a breakdown of shop drawing items.

3. Submit certification that all equipment is UL listed.

4. Shop drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices.

5. This list does not necessarily include all items of shop drawings required. The Engineer reserves the right to request additional shop drawings.

B. Installation, Operation and Maintenance Manuals:

1. Submit required number of installation, operation and maintenance manuals for all equipment being provided for the electrical system. These manuals shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly and indexed.

2. The installation, operation and maintenance manuals shall include a copy of the approved shop drawings for all electrical items installed on the project.

## 1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Product Handling:

1. Deliver all materials in good condition. Store in dry place, off ground, and keep dry at all times.

B. Protection of Installation:

1. All unfinished installations, construction materials and equipment shall be protected during construction.

**PART 2 PRODUCTS**

**2.1 SEE SPECIFIC SECTIONS FOR PRODUCTS**

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Protection of Installation:

1. All equipment shall be protected during construction. All damaged equipment caused by noncompliance with this requirement shall be repaired at no expense to the Owner.

B. Position of Outlets and Equipment:

1. The Owner shall determine the position of all relocated outlets and equipment if the required location differs from that indicated on the drawings.

C. Moving Outlets and Equipment:

1. The Owner reserves the right to move any outlet, or equipment enclosure, a distance of ten feet before roughing in, at no additional expense.

D. Methods and Materials:

1. All work shall be installed in a first-class, neat and workmanlike manner by skilled mechanics. All materials shall be new. Firmly support all materials and equipment.

E. Cutting, Repairing and Finishing:

1. All cutting, repairing and finishing required for the installation of work under this Contract shall be performed under this Contract.

2. All disturbed surfaces shall be repaired and finished to match adjacent surfaces by skilled mechanics working in their respective fields.

F. Excavation and Backfilling:

1. Excavation and backfilling will be in accordance with the requirements of Division 2 and as required to complete the work according to details on the Drawings.

G. Concrete:

1. Concrete work shall be in provided in accordance with the requirements of Division 3 and as required to complete the work according to details on the Drawings.

H. Cutting and Patching of Macadam and Concrete Areas:

1. Openings in concrete or macadam required for Electrical construction shall be made by taking extreme precautions to prevent excessive damage to existing facilities. Prior to completion, all disturbed areas shall be closed, restored to normal and finished to match surrounding areas.

I. Access:

1. Install all conduit, wire, cable, wiring devices and equipment to preserve access to all equipment installed under this Contract.

J. Layout of Wiring:

1. The layout of wiring as shown on the drawings shall not be considered as absolute. It shall be subject to changes where necessary to overcome obstacles in construction. Where a major deviation from the plans is indicated by practical consideration, shop drawings shall be submitted showing all deviations in detail to clearly indicate the necessity or desirability for the change.

K. Miscellaneous Supports:

1. Furnish and install all necessary angles, beams, channels, hanger rods or other supports for equipment and piping furnished under this Contract requiring support or suspension from building structure.

L. Continuity of Service:

1. Uninterrupted electrical service shall be maintained during the entire time required for complete installation of the work contemplated under these specifications and drawings.

2. Temporary equipment, cable and whatever else is necessary shall be provided as required to maintain electrical service. Temporary service facilities, if required at any time, shall not be disconnected or removed until new services are placed in proper operation.

3. If any service or system must be interrupted, the Contractor shall request permission in writing stating the date, time, etc. the same will be interrupted and the areas affected. This request shall be made in sufficient time for proper arrangements to be made. Written permission shall be obtained from the Owner before interrupting electrical service.

M. Clean Up:

1. Upon completion of all work under electrical specifications, furnish labor, materials and incidentals to accomplish the following: remove all dirt, foreign materials, stains, fingerprints, etc. from all electrical equipment enclosures, panelboards, and system equipment, and leave the electrical work in such a condition that no cleaning will be required by the Owner. The complete system shall be subject to inspection and approval by the Owner.

## 3.2 COORDINATION AND ARC FLASH STUDY

A. General:

1. A short-circuit, component protection, flash hazard analysis, and selective coordination study shall be made for the entire electrical distribution system, beginning at utility connections and ending at the largest feeder from each motor control center or panel but in no case will study terminate before AIC values are below 10,000 amps.

2. The company performing the study shall attend one (1) meeting with the Owner and the Engineer to review the study requirements prior to performing the study. This meeting shall be held at the wastewater treatment plant.

B. References:

1. The coordination study shall be completed in accordance with the latest edition of IEEE Standard 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

2. The flash hazard analysis shall be completed in accordance with the latest editions of NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces and IEEE Standard 1584 - Guide for Performing Arc-Flash Hazard Calculations.

C. The short circuit study shall consist of the following:

1. Momentary and interrupting values of short circuit shall be calculated for three-phase bolted faults at each bus having a protective device. Fault current calculations shall consider the contribution of all significant synchronous and/or induction motors. Motors less than 15 hp at one location shall be represented as a lump sum, and motors 15 hp and larger shall be represented individually. Motor horsepower's shall be obtained from the Contract Drawings, including applicable Addenda, by the firm performing the fault study.

2. Questions regarding the starting, running and construction characteristics of individual motors shall be coordinated directly with the associated equipment manufacturer by the firm performing the fault study.

3. Motor subtransient reactances shall be used for the calculation of momentary fault current values. A final tabulation of short circuit calculations shall include X to R ratios, asymmetry factors, short circuit kVA and symmetrical fault current values for each bus. In addition to this tabulation, provide a tabulation showing protective device interrupting capacity versus available fault current.

4. Recommendations which may be required in order to insure safe fault current interruption shall also form a part of the final report.

D. The coordination study shall consist of the following:

1. All protective devices contained in the scope of work shall be set to provide the best possible coordination and protection. The coordination study shall include log-log plots of phase overcurrent and ground overcurrent protection devices on K & E time-current characteristic paper. Complete plots of these devices will be accurately plotted through their operating range. A sketch shall be included on each plot sheet showing device identification.

2. Attempts will be made to obtain complete coordination on every portion of the system. Appropriate maximum fault levels, transformer inrush currents, conductor insulation withstand curves and transformer withstand points shall be plotted on each coordination plot sheet to assure adequate component protection and maximum system reliability.

3. Each current transformer shall be checked for saturation to insure that they accurately translate all fault currents which may be available on the system. A complete and thorough discussion of each coordination curve sheet shall be prepared. This discussion will describe the areas where coordination is effective, as well as any instances where a lack of coordination exists. All protective relay settings, fuse sizes and low-voltage circuit breaker settings will be tabulated.

4. Recommendations for new equipment or conductor changes which may be necessary to improve protection and/or coordination will also be contained in a section of the completed coordination study.

E. Arc Flash Hazard Analysis:

1. The study shall include a flash hazard analysis for the electrical distribution equipment. The analysis shall determine the flash protection boundary, incident energy, and required level of personal protective equipment (PPE) for workers at the electrical distribution equipment. The flash protection boundary and incident energy shall be determined based upon a working distance of 18 inches. The electrical distribution equipment shall be field marked with this information in accordance with codes and standards.

2. The arc flash labels shall be furnished and installed by the Contractor.

F. A complete set of coordination curves, starting with the main switchboard devices protecting the service down through and including all on-site service, feeder, sub-feeder, and secondary main and branch circuit devices, shall be provided.

G. The final selection and setting of overcurrent devices shall be based on this coordination study. Study Contractor to coordinate with settings for overcurrent devices in conjunction with the switchgear manufacturer.

H. The Study Contractor shall coordinate ground fault protection.

I. Submissions and approval of this study are required prior to final approval of shop drawings.

J. Motor starting voltage profiles for all large motors shall be provided.

K. The Contractor shall make all settings as recommended by the coordination study.

L. A factory representative for the switchgear shall be present when the Contractor adjusts, tests and calibrates devices as required in the field after the installation is complete. The number of days required to do this work shall be the manufacturer's responsibility and shall be included in the bid.

M. Points of non-coordination shall be brought to the attention of the Engineer, along with recommendations by Contractor and manufacturers involved.

N. This study shall be made by an independent electrical testing company. Acceptable testing companies are Square D, or equal.

O. The final study, along with the SKM Power tools Project file (.PRJ), shall be submitted to the Owner on a CD.

**END OF SECTION 26 00 00**

# SECTION 26 05 00

# BASIC MATERIALS AND METHODS

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Work Included:

1. All items of labor, materials and equipment necessary for the complete installation and proper operation of work described or implied, shall be furnished and installed.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute, Inc. |
| ASTM | American Society for Testing and Materials |
| BOCA | Building Officials and Code Administrators |
| IEEE | Institute of Electrical and Electronic Engineers |
| IPCEA | Insulated Power Cable Engineers Association |
| NEC | National Electrical Code of National Fire Protection Association |
| NEMA | National Electrical Manufacturers Association |
| NESC | National Electrical Safety Code |
| UL | Underwriters' Laboratories |

B. Qualification of Manufacturers:

1. Various materials specified herein shall be as supplied by manufacturers listed under PRODUCTS.

C. Quality Control:

1. All equipment shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at time of bidding. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the manufacturer's drawings.

3. Submit manufacturer's latest publications for the following items:

    a. Conduit and Fittings
    b. Wire
    c. Instrumentation Cable
    d. Outlet Boxes
    e. Junction Boxes
    f. Pull Boxes
    g. Convenience Receptacles
    h. Local Control Switches
    i. Panelboards
    j. Transformers
    k. Manual Starter Switches
    l. Disconnect Switches
    m. Electrical Manholes
    n. Uni-Strut
    o. Conduit Link Seals
    p. Conduit Labels

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Conduit:

1. PVC conduit shall be Schedule 40, suitable for installation underground.

2. Rigid steel conduit shall be mild steel piping, zinc coated, and of sufficient weight and toughness to withstand cracking and peeling during bending. Galvanizing to be a coating of zinc of uniform thickness applied by either electrolytic or hot metal dip process.

3. Rigid aluminum conduit shall be 6063-T1 aluminum alloy and shall comply with Federal Specification WW-C-540C.

4. Each piece of rigid conduit to be straight, free from blisters and defects, cut square and taper reamed, finished in 10' lengths and threaded at each end. Couplings shall be supplied at one end and a protective sleeve for the other end. All threads shall be clearly cut. Each length of conduit shall bear Underwriters' Label.

5. PVC coated galvanized rigid steel conduit shall have a permanent plastic coating factory applied to a minimum thickness of 40 mils and a urethane internal coating. PVC coated conduit shall be Plasti-Bond Red $H_2OT$ as manufactured by Robroy Industries, or Perma-Cote Supreme as manufactured by Perma-Cote Industries.

6. Electrical metallic tubing shall be open-hearth with electro-galvanized coating or hot metal dip process on exterior and of sufficient weight and strength to withstand cracking and peeling during bending. Each length of conduit shall bear the Underwriter’s Label.

7. Flexible metallic conduit shall conform to Articles 350 and 351 of the NEC and shall be UL listed. All flexible metallic conduit shall have nonmetallic screw-in type connectors and couplings. All flexible conduit shall be liquid-tight type. Flexible conduit in wet locations and chemical feed areas shall be non-metallic.

8. Minimum size of rigid conduit shall be 3/4". Minimum size of flexible conduit shall be 1/2”.

B. Wire:

1. Wire shall be type THHN/THWN, except for underground wiring, which shall be type XHHW. All wiring shall be stranded, copper with 600 volt insulation. Aluminum wire will not be acceptable.

2. Wire shall be 90°C, suitable for wet or dry locations.

C. Instrumentation Cable:

1. Instrumentation cable for analog signal wiring shall be #18 AWG twisted shielded pairs with tinned copper conductors, 300 volt polyethylene insulation, a continuous foil shield with 100% coverage, and a tinned copper drain wire.

2. The instrumentation cable shall be Beldon #8760, or equal.

D. Cast Fittings:

1. Cast fittings for steel conduit shall be made of rust resisting alloy of iron or steel. An iron fitting shall be cast malleable iron thoroughly coated with metallic zinc or cadmium inside and outside after all machine work is completed.

2. Cast fittings for aluminum conduit shall be made of aluminum. The conduit fittings shall be for rigid conduit. Combination type conduit fittings with set screws will not be acceptable. Conduit fittings shall be O-Z/Gedney, or equal.

3. Each cast fitting shall be provided with heavy threaded hubs to fit the conduit used. A cast fitting shall be used on all exposed conduit runs except at impractical locations where factory ells may be used.

4. All cast fittings used for PVC coated conduit shall be PVC coated and shall be Form 8 with encapsulated screws.

5. All fittings in wet locations shall be gasketed.

E. Outlet Boxes:

1. Each outlet box shall be sized in accordance with current editions of all Federal, State and local codes.

2. All outlet boxes shall have mounting lugs or ears for mounting wiring devices and covers. Each outlet box shall be equipped with an appropriate cover.

3. Outlet boxes shall be cast type of same construction as cast fittings described above.

F. Junction Boxes:

1. Junction boxes shall be cast type, and shall be of same construction as cast fittings, unless noted otherwise on the Drawings.

2. Junction boxes identified on the Drawings as NEMA 4X aluminum shall be constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

3. Label all junction boxes with an engraved nameplate fastened to the junction box. Nameplate shall be black with 1/4” white lettering.

G. Pull Boxes:

1. Pull boxes shall be aluminum, constructed of Type 5052 H-32 aluminum, and shall have gasketed shoe box type covers with stainless steel screws.

2. Label all pull boxes with an engraved nameplate fastened to the pull box. Nameplate shall be black with 1/4” white lettering.

H. Panelboards:

1. Panelboards shall be dead front automatic circuit breaker type suitable for connection to the system characteristics and with circuit breakers as called for on the panel schedules. Circuit breakers shall be thermal-magnetic type with quick-make, quick-break operating mechanism and with trip indication. Trip indication shall be clearly indicated by breaker handle taking a position between “ON” and “OFF”. All 2-pole and 3-pole breakers shall be common trip. Breakers shall be plug-in type.

2. Bus bars shall be plated copper. Lugs shall be plated copper. The ampere rating of the main bus bars and lugs on each panelboard schedule shall be considered a minimum. Larger ampere rating main bus bars and lugs may be required to accommodate the number of poles indicated on the panelboard schedules or to accommodate large wire sizes. Breakers used as switches shall be rated for that purpose.

3. Panelboard box shall be made of code gauge galvanized steel, factory assembled as a complete unit and large enough to provide ample wiring space.

4. Panelboard front shall be complete with door and flush chrome plated pin type cylinder lock and catch. All panelboards shall be keyed alike. Front shall have adjustable indicating trim clamps which are completely concealed when the door is closed. Door shall be mounted with completely concealed hinges.

5. Unless otherwise noted on plan, panelboard shall have all breakers with a minimum interrupting capacity of 10,000 Amps symmetrical, and boxes with a minimum width of 20".

6. Panels shall be factory prime coated and finish coated with baked acrylic enamel. Label all panelboards with an engraved nameplate fastened to the front of the panel. Nameplate shall be black with 1/4” white lettering.

7. Panelboards shall be Square D.

I. Transformers:

1. Transformers shall be size and voltage as indicated on Drawings, dry type, ventilated, floor mounted, 115ºC temperature rise with 220ºC insulation system.

2. Transformers shall have aluminum windings, and shall be energy efficient, DOE 2016 compliant.

3. Transformers shall be Square D.

J. 15 Ampere, 120 Volt, Single Receptacles, NEMA 5-15R:

1. Single receptacles shall be corrosion resistant, 15 ampere, 3 wire, U-ground to meet Federal Specification WC-596. Receptacle color shall be yellow.

2. Single receptacles shall be Arrow Hart #5361-CR, Hubbell #53CM61, or Leviton #5361-CR, or equal.

K. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R:

1. Duplex receptacles shall be 3 wire, U-ground, to meet Federal Specification WC-596. Receptacle color shall be ivory.

2. Receptacles shall be Arrow Hart #5362, Bryant #5362, Hubbell #5362, Leviton #5362, Pass &Seymour #5362, or equal.

L. 20 Ampere, 120 Volt, Duplex Receptacles, NEMA 5-20R (G.F.I. Type):

1. All receptacles noted, as G.F.I. receptacles shall be 20 Amp ground fault circuit interrupter receptacles. Receptacles shall be the "Standard" End-of-Line" type, which protects itself only. "Feed-Thru" installation will not be permitted. Devices shall be Class A, UL listed.

2. Provide a weatherproof cover for G.F.I. receptacles where indicated on the Drawings. Cover shall be self-closing and UL listed.

M. Switches:

1. Local control switches, other than those mounted on a panelboard, shall be 20 ampere, 120-277 volt, AC, meeting Federal Specification WS-896E. Switch color shall be ivory.

2. Switches shall be single pole, double pole, three-way, four-way, or type as noted.

3. Switches shall be Arrow Hart #1221, Bryant #4901, Hubbell #1221, Leviton #1221, Pass & Seymour #20AC, or equal.

4. Provide explosion-proof switches where indicated on the Drawings.

N. Wall Plates:

1. Local control switches, receptacles and similar wiring devices shall be provided with stainless steel wall plates with beveled edges. Plates shall be same manufacturer as wiring device used.

2. At locations where FS condulets are used for switches or receptacle outlets, an FS condulet plate shall be used. Plates shall have beveled or rounded edges and shall fit flush with all sides of the FS condulet.

O. Manual Starter Switches:

1. Manual starter switches shall consist of a single pole snap switch and a thermal overload device. Size of overload element shall be based on the nameplate rating of the motor it is to protect. Switches shall be furnished with a red pilot light and an H/O/A switch. Switches shall be mounted in an outlet box where wiring is concealed and in a condulet box where wiring is exposed.

2. Manual starter switches shall be rated for 1 hp at 120V AC and shall be manufactured by Square D or Allen-Bradley.

P. Disconnect Switches:

1. Disconnect switches shall be non-fusible, size and NEMA enclosure as indicated on the Drawings, quick-make, quick-break, heavy-duty. Provide a ground lug in each disconnect switch.

2. NEMA 4X disconnect switches shall be 316 stainless steel, unless noted otherwise.

3. Label all disconnect switches with an engraved nameplate fastened to the disconnect switch.

4. Disconnect switches shall be Square D.

Q. Concrete Electrical Manholes:

1. Precast concrete manholes shall be manufactured under controlled conditions, not subject to the elements, using steel forms, internal and external vibrations of concrete, and subject to periodic testing and control of the Construction Materials Testing Institute.

2. Concrete shall be produced on a performance basis using 7½ bag mix cement. The strength of the concrete shall be at or greater than 3500 p.s.i. in 28 days or at time of delivery. The design strength is determined by ASTM-C-94, Section 15, Table 1, with coefficient of variation of 15% and a required over design factor of 1.14.

3. Basis for concrete strength is the 6 x 12 test cylinder made in conformance with ASTM-C-31 and tested in conformance with ASTM-C-39.

4. Placing of the concrete shall be done under controlled conditions with temperatures varying not lower than 50°F or higher than 85°F. Units are to be allowed to cure for 24 hours before removal to drying yards.

5. Steel reinforcing shall be H-20 bridge loading proven by calculations drawn by a Registered Structural Engineer using new billet steel welded into cages and installed in steel forms before pouring of concrete.

6. Manhole shall have heavy-duty frames and lids. Lids shall be self-sealing and shall be stamped "ELECTRIC".

7. Manholes shall be provided with a fiberglass ladder leading to the bottom of the manhole.

8. Manholes shall be provided with nonmetallic cable racks as required.

9. All joints shall be sealed with plastic gaskets. All joints shall be sealed watertight.

10. The manholes shall be waterproofed by applying two coats of Cooper-Black 760 top-service black protective coating to the outside surfaces of the manhole. The coating shall be applied in strict accordance with the manufacturer’s recommendations. Final dry mils thickness shall be 12 mils.

11. Manholes shall be manufactured by A.C. Miller, Penn Cast, or equal.

R. Uni-strut:

1. Uni-strut shall be used where indicated on the drawings to support conduit and electrical equipment.

2. All metal uni-strut shall be 316 stainless steel.

3. Fiberglass uni-strut shall be manufactured by Enduro, or equal.

S. Conduit Link Seals:

1. Conduit link seals shall be installed in all core-drilled holes for sealing around the conduit. All link seal bolts shall be stainless steel.

T. Conduit Labels:

1. Conduit labels shall be PVC sleeves that wrap around conduit. Labels shall indicate the voltage of the wiring inside the conduit.

U. Fire Resistant Foam Sealant:

1. All penetrations through floors and walls shall be sealed with Nelson Firestop Products CLK, Cat. #AA492, silicon based sealant, or equal.

2. All wall or floor penetration openings shall be as small as possible.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Conduit:

1. All direct buried conduit shall be PVC coated galvanized rigid steel, unless noted otherwise on Drawings.

2. All conduits embedded in concrete slabs shall be PVC, unless noted otherwise. Where conduits turn up out of the slab, they shall be PVC coated galvanized rigid steel.

3. All PVC conduits in concrete duct banks shall transition to PVC coated galvanized rigid steel where they turn up above finished grade.

4. All buried conduit for motor feeders from VFDs, and for analog instrumentation, shall be PVC coated galvanized rigid steel.

5. All exterior exposed conduit shall be rigid aluminum.

6. All exposed conduit in buildings shall be rigid aluminum, unless noted otherwise on the Drawings.

7. All exposed conduit in chemical feed rooms, shall be PVC coated galvanized rigid steel.

8. All wiring shall be run in conduit.

9. Install conduit so wires may be removed and replaced at a later date.

10. Short runs of flexible nonmetallic conduit with separate ground wire shall be used for connection of motors and instrumentation. Approximately 18" runs of flexible nonmetallic conduit shall be used for connection of all HVAC equipment. No rigid connection to HVAC equipment will be permitted.

11. Running threads will not be permitted. Use an approved threaded coupling or a suitable union where required. Setscrew couplings will not be permitted.

12. Space supports for conduit not more than 5' apart. Support conduit by one-hole malleable iron pipe straps or beam clamps. Where it is impractical to use beam clamps and where conduit is installed on building surfaces, use back straps and approved fastening devices with malleable iron pipe straps. All straps and clamps for PVC coated conduit shall be permanently PVC coated by same manufacturer as conduit.

13. Where it is necessary to cross building expansion joints, provide conduit runs with suitable expansion fittings.

14. Provide conduit expansion fittings in aluminum conduit at 30'-0" intervals.

15. No horizontal runs of conduit will be permitted in masonry walls.

16. All conduit penetrations into electrical equipment enclosures shall be made using conduit hubs. PVC coated rigid steel conduit systems shall use PVC coated conduit hubs.

17. Bend conduit only by use of an approved pipe bending machine or hickey so the conduit will always retain its cylindrical shape. PVC coated conduit shall be bent and threaded only with tools manufactured for that purpose.

18. If the PVC coating on conduit and fittings is damaged during installation, the damaged conduit or fitting shall be replaced in its entirety by the contractor. Repairing damaged conduit with touch-up paint will not be acceptable.

19. Install metallic electrical warning tape above all underground duct banks and conduit. Tape shall be 6" wide with yellow background and black letters. Letters shall read "CAUTION ELECTRICAL LINE BURIED BELOW". Install tape 6" below finished grade.

20. Label all exposed conduits at each end of the conduit run.

B. Outlet Boxes:

1. An outlet box shall be furnished and installed at each outlet, firmly in place, and set true and square.

2. All outlet boxes shall be supported from the building structure, independent of the entering conduit. All unused knockouts must remain closed.

C. Wiring:

1. The voltage drop at the end of any circuit shall not exceed 3% of the normal line voltage under full load. No wires smaller than #12 AWG shall be used for branch circuits; pilot and control circuits shall not be smaller than #14 AWG.

2. Care shall be exercised in pulling wire into conduit so as not to injure insulation. Use pulling compound as required.

3. Conductors to be continuous from outlet to outlet. Splice only within outlet or junction boxes.

4. Balance circuits across the phase wires of the branch and distribution panels. Run separate neutral wires for all circuits.

5. Switches shall not be connected to the neutral conductor.

6. Power and control wiring shall be run in separate conduits. AC and DC circuits shall be run in separate conduits.

7. All wiring shall conform to the following color code:

| | |
|---|---|
| 480 Volt, 3 Phase: | Brown, Orange, Yellow - Phase Wires<br>Gray - Neutral Wire |
| 208 Volt, 3 Phase: | Black, Red, Blue - Phase Wires<br>White - Neutral Wire |

| | |
|---|---|
| 208 Volt, 1 Phase: | Black, Red - Phase Wires<br>White - Neutral Wire |
| 208 Volt, 1 Phase: | Black, Red - Phase Wires |
| 120 Volt, 1 Phase: | Black - Phase Wire<br>White - Neutral Wire |
| Control Wires: | 120V AC - Red<br>24V dc - Blue |
| Ground Wires: | Green |

8. AC control wires energized from a source external to the control panel power source shall be yellow.

9. All control wiring shall be identified at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be heat-shrink white PVC tubing with machine printed black marking, as manufactured by Brady Markings shall be in accordance with the wire numbers and terminal numbers shown on the control panel wiring diagrams.

D. Splices:

1. Make all splices using solderless connectors. Use wire nut connectors composed of expandable spring steel shell and PVC insulator for size #14 through #8. Temperature rating shall be 105°C. For size #6 and larger, use bolted-type tinned copper pressure connectors, either the straight coupling type or the split bolt type.

2. All connectors #6 and larger shall be wrapped with UL approved linerless rubber splicing tape rated to 69 KV and vinyl plastic electrical tape to the same thickness as the insulation of the wire. Electrical tape shall be Scotch 33+, or equal.

E. Lugs:

1. All lugs used with copper wire and cable shall be tinned copper. Aluminum will not be accepted.

F. Panels:

1. Furnish a typed list identifying all circuits and insert in frames provided inside of panel doors.

G. Mounting Heights:

1. Mounting heights and exact locations of all outlets to be verified by the Owner before roughing in.

2. Unless otherwise instructed, outlets shall be located as follows:

a. Local Lighting Control Switches: Locate all outlets for single or gang switches 3'-4" above finished floor on strike side of door. If this location places the switch group partly in tile or other finishes, the outlet shall be lowered or raised to place the plate entirely on a flat surface.

b. Duplex Receptacles: 18" above finished floor in office areas, and 36” above finished floor in process areas, unless noted otherwise on the Drawings.

c. Panelboards: 6'-0" above finished floor to top of panel.

d. Disconnect Switches: 5'-0" above finished floor to top of switch, unless noted otherwise on the Drawings.

e. Control Panels: 6'-0" above finished floor to top of panel, unless noted otherwise on the Drawings.

**END OF SECTION 26 05 00**

# SECTION 26 05 26

# GROUNDING SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish all labor and materials required to complete all work necessary for an electric service and branch distribution grounding system. System shall include but not be limited to all grounding electrodes, ring conductors, connectors, and miscellaneous accessories such as bonding lugs, bushings and jumpers in accordance with the current edition of the National Electrical Code and as specified herein.

2. In addition to grounding/bonding connections required to comply with NEC provisions, a grounding ring system shall be installed as indicated herein or on the Drawings. This system is intended to provide bonding between all process and structural components and the electrical distribution system grounding. The description "process piping" where included herein shall be understood to mean all metallic piping systems where they occur on the site. Other process and structural components shall be grounded as specifically described herein to provide a complete system with all metallic components at the site bonded together.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute, Inc. |
| ASTM | American Society for Testing and Materials |
| IEEE | Institute of Electrical and Electronic Engineers |
| NEC | National Electrical Code of National Fire Protection Association |
| UL | Underwriters' Laboratories |

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings and types of materials.

2. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the Drawings and in these Specifications. All pertinent Specification and Drawing requirements shall be indicated on the manufacturer's drawings. Submit shop drawings on the following:

a. Grounding Electrodes
b. Grounding Conductors
c. Grounding Conductor Connectors
d. Conduit Grounding Bushings
e. Conduit Grounding Jumpers

f. Exothermic Weld Process and Components
g. Grounding System Resistance Test Equipment
h. Grounding System Test Point Sleeves

B. Literature:

1. Submit manufacturer's latest publications for each item.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

A. Grounding Electrodes:

1. Grounding electrodes shall be 10'-0" long, 3/4" diameter copper clad steel. Exterior shall be electrolytic copper metallically bonded to a round one-piece carbon steel rod. The electrodes shall be fabricated so as to prevent mushrooming of rod head during driving, or a steel-driving stud, manufactured for such a purpose, shall be used.

2. Electrodes shall conform to the requirements of UL Specification No. 467 (ANSI C-33.8-1972).

3. Electrodes shall be Blackburn, Carolina, or equal.

B. Ground Conductors:

1. Electric service ground conductor shall be sized in accordance with NEC Article 250-66 and shall be connected to the associated building/structure grounding ring as well as all other equipment and building components required by the NEC.

2. The grounding rings shall be annealed temper, stranded, bare, copper, uncoated type. Individual members of stranded conductor shall meet the requirements of ASTM B3, and the overall fabrication shall meet the requirements of ASTM B8 for stranded conductors.

3. Size of grounding ring conductors shall be #4/0 AWG.

4. All connections between the grounding ring and the individual equipment or building/structure components called for to be grounded herein shall be made using #2/0 AWG copper cable of the same type as the grounding rings.

C. Grounding Jumpers:

1. UL listed jumpers shall be provided on all metallic conduit expansion fittings whether or not the circuit is provided with a separate ground conductor. Jumpers shall be braided, tinned copper, factory connected as a single assembly to two galvanized steel U-bolts. OZ Gedney Type "BJ" (for steel conduit), or equal.

D. Grounding Bus:

1. All power distribution equipment, motor control centers, panelboards, terminal boxes, transformers, etc. shall be furnished with a factory installed grounding bus or termination point.

E. Electrical Conduit Grounding Bushings:

1. Conduit connectors shall be insulated bushing type for grounding and bonding. Fitting shall have ground lug terminal as well as a bonding setscrew in the circumference of the bushing. Appleton "G1B" series, OZ Gedney "BLG" series, Steel City "BG" series or equal.

F. Exothermic Weld Connections:

1. All underground grounding system connections shall be exothermically welded, including all cable connections to grounding electrodes (rods), concrete reinforcing and any other utilities required to be grounded but are not accessible from above grade.

2. The welding process shall use a mixture of copper oxide and aluminum packaged according to connection type in plastic tubes. The packages shall be nonexplosive and shall not be subject to spontaneous ignition.

3. All welding materials used shall be Cadweld as manufactured by Erico Products, Inc. or equal and shall meet or exceed the requirements of IEEE Standards 80 and 837 and as listed in MIL 419.

G. Exposed Mechanical Type Grounding System Connectors:

1. The following equipment, structural and nonstructural components at the site shall be connected with a #2/0 AWG, soft-drawn, stranded, tinned copper, bare grounding conductor with the described materials or fitting to the associated building or structure grounding ring. (These items are in addition to the electrical distribution grounding requirements described elsewhere herein.) In addition to the component and fitting manufacturers listed herein and on the Standard Details, fittings and components manufactured by Burndy, OZ Gedney, Dossert or Teledyne/Penn-Union will also be accepted:

a. Motor Control Centers
b. Emergency Generator
c. Process Piping:

1) 1/2" to 1-1/2" - OZ Gedney Type "ABG"
2) 1-1/4" to 12" - OZ Gedney Type "G" bronze heavy-duty ground clamps with Type "GWB" dead end terminal hub
3) Larger than 12" - OZ Gedney Type "XL" single hole lug mounted to a single process pipe flange bolt.

d. Concrete slab reinforcing steel

2. Components used for grounding conductor connections shall be as indicated herein or on the Drawings.

H. Grounding Conductor Connection Lugs:

1. Grounding conductor connection lugs shall be aluminum for all connections to aluminum materials. Grounding conductor connection lugs for connections to all other materials shall be copper. All aluminum-to-copper connections shall be made according to the lug manufacturer's recommendations using an appropriate cleaning and oxidation prevention compound, Penetrox A-13 or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. General:

1. Grounding system shall comply with the current edition of the National Electrical Code, the current edition of the National Electrical Safety Code and as specified herein.

2. Flexible conduit to motors shall not be used as a ground conductor.

3. All ground conductors shall be copper and sized according to the requirements of the NEC, Table 250-66 and Table 250-122 as applicable.

4. All conduits shall be furnished with a separate ground conductor. Conduits shall not be used as a ground conductor.

5. All metallic electrical conduits shall be bonded to the equipment ground terminal, ground wire or ground bus using an insulated ground bushing and jumpers sized as required by the NEC. Bond shall be provided at all conduit terminations.

6. Flexible jumpers (bonding straps) shall be installed where conduit expansion fittings occur.

7. Ground conductors shall be green, insulated stranded type where installed in conduit.

8. Grounding ring and all associated conductors shall be soft drawn, stranded copper, size 4/0, bare type.

9. Unless otherwise indicated on the drawings or in the specifications, all copper-to-copper or copper-to-steel splices and terminations for ground ring and connections to the ground ring shall be made by controlled exothermic reaction welding process, using the appropriate fittings for the process employed. Steel shall be ground or filed, and copper conductors shall be cleaned, to ensure all surfaces are clean, dry and free from oxide before welding process is performed.

10. System ground ring and top of ground electrodes shall be direct buried to a minimum depth of 24" and a maximum depth of 30". Electrodes shall be driven straight down, perpendicular to the finished grade.

11. Ground electrodes in the ground ring shall be installed at no less than 10' intervals nor greater than 20' intervals.

12. The term "grounding ring" shall be understood to mean a copper conductor, as specified of this Section, buried and connected to grounding electrodes (driven rods) at + 15'-0" intervals, to completely encircle the associated building or structure. Splices in and connections to the copper conductor and grounding electrodes shall be made using an exothermic weld process, as described of this Section.

13. All metallic water piping systems shall be connected to the building's associated ground ring at two locations. Where flow meters, valves, flexible piping or any type of nonmetallic connection occur in a piping system, a bonding jumper shall be installed around the device to ensure ground continuity. Jumpers installed under other portions of these specifications, such as reference grounds for process flow meters, etc., shall not be used to replace or be considered as grounding system jumpers.

14. Rebar in concrete structures shall be connected to the grounding ring at two locations for each structure.

15. The ground ring shall be furnished with test points as indicated on the drawings. The test points shall consist of a 6" diameter, Schedule 40 PVC conduit brought flush with finished grade and extending down to 4" below point on ground rod where ring conductor is attached. The PVC shall be notched as required to prevent stress on the ground ring conductor if the PVC conduit is pushed downward from grade for any reason. Provide threaded end cap on top of PVC conduit. End cap shall be labeled "GROUND TEST POINT".

16. Testing of actual ground resistance shall be made by the Contractor before any finish landscaping is accomplished. Testing shall not be performed until after all underground connections are made and buried and after all structural steel has been connected to the ground ring. Test shall be made at the ground ring using a megger type ground tester and the "fall of potential" test method. Maximum resistance at the test point shall be 5 ohms unless otherwise noted. Where measured values exceed the above figures, the Contractor shall install additional electrodes at no additional cost to the Owner until further tests indicate the ground resistance has been reduced to the specified limit.

**END OF SECTION 26 05 26**

# SECTION 26 21 00

# ELECTRIC SERVICE

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish all labor and materials to remove the existing electric service to the treatment plant and install a complete new electric service to the plant including termination, metering, conduit, and all equipment and labor required, as indicated on Drawings and specified herein.

2. Service characteristics for the new electric service are 277/480 volt, 3 phase, 4 wire wye. The power company is Potomac Edison.

### 1.2 QUALITY ASSURANCE

A. Contact the power company for specific instructions regarding service requirements before beginning work. Complete system must meet with power company approval.

B. Power company contact is Rick Usary. Telephone number is 301-582-5210.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Primary Service Conduits:

1. Primary service conduits shall be PVC Schedule 40 encased in a concrete duct bank.

B. Secondary Service Conduits:

1. Secondary service conduits shall be PVC Schedule 40, encased in a concrete duct bank.

## PART 3 EXECUTION

### 3.1 REMOVAL OF EXISTING ELECTRIC SERVICE

A. General:

1. The Contractor shall remove the existing electric service to the treatment plant, including pad mounted transformer and secondary electric service. Written permission must be obtained from the Owner prior to the removal of the existing service.

2. Coordinate all service removal requirements with the power company.

### 3.2 INSTALLATION OF NEW ELECTRIC SERVICE

A. General:

1. The Contractor shall install a complete new electric service to the treatment plant, including pad mounted transformer, and underground primary and secondary electric service as shown on the Drawings and specified herein.

2. Coordinate all service installation requirements with the power company.

B. Primary Service Conduits:

1. Primary service conduits shall start at the electric service pad and run underground to the pad mounted transformer. Primary service conduits shall be furnished and installed by the Contractor.

C. Secondary Service Conduits:

1. Secondary service conduits shall start at the pad mounted transformer and run underground to the Main Distribution Switchboard located in the Control Building. Secondary service conduits shall be furnished and installed by the Contractor.

D. Primary Service Conductors:

1. Primary service conductors shall be furnished and installed by the power company in the primary service conduits.

E. Secondary Service Conductors:

1. Secondary service conductors shall be furnished and installed by the Contractor in the secondary service conduits, as indicated on the Drawings.

F. Electric Metering:

1. The electric metering shall be furnished by the power company on the pad mounted transformer.

G. Costs:

1. All power company costs for the installation of the new electric service will be paid by the Owner.

**END OF SECTION 26 21 00**

# SECTION 26 24 13

# MAIN DISTRIBUTION SWITCHBOARD

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work included:

1. Furnish all labor and materials to install a main distribution switchboard, and associated items, as indicated on the Drawings and specified herein.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| ANSI | American National Standards Institute, Inc. |
| IEEE | Institute of Electrical and Electronic Engineers |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories, Inc. |

B. All internal conductors are to be of sufficient cross-sectional area to carry the rated ampere load and not exceed the maximum heat rise above ambient temperature as specified by UL and NEMA.

C. Quality Control:

1. The switchboard shall be new and limited to products regularly produced and recommended for service ratings in accordance with engineering data or other comprehensive literature made available and in effect at time of bidding. In all cases where device, or devices, or part of equipment is herein referred to in singular, reference shall apply to as many items as required to complete installation.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit in accordance with the General Requirements. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, rating, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information on the following:

a. Main Breaker
b. Generator Breakers
c. Power Monitor
d. Surge Protective Device
e. Automatic Transfer Switch
f. Distribution Circuit Breakers

### 1.4 MANUFACTURER

A. The switchboard shall be Square D Style QED-2.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Switchboard Structure and Configuration:

1. Switchboard shall be NEMA Type 1, freestanding, totally enclosed, with 90" high cubicles.

2. The switchboard shall be designed and manufactured to be front accessible. Switchboard will be bottom fed.

3. A ground bus shall be furnished to extend the full length of the switchboard.

4. Trip setting of all breakers shall be visible without removing trim on cover.

5. All internal conductors are to be plated copper bus bars with sufficient cross-sectional area to limit the temperature rise to 65 degrees C.

6. All horizontal busses shall be full capacity non-tapered copper as shown on the Drawings.

7. Bus shall be totally plated copper.

8. Main horizontal bus must be braced for 65,000 rms Amps.

9. Bus arrangement shall be phase A-B-C left to right, top to bottom and front to rear as viewed from the front of the switchboard.

10. All field control wiring for the switchboard shall be terminated on terminal blocks inside the switchboard.

11. All control wiring in the switchboard shall be labeled.

B. Power Monitor:

1. Provide a power monitor in the switchboard for complete electrical metering. The power monitor shall be a microprocessor based monitoring device that provides complete electrical metering and system voltage protection.

2. The power monitor shall have an alarm contact for remote indication of a power failure. This contact shall be wired to terminals in the switchboard for wiring to the plant PLC System.

3. The power monitor shall output a 4-20mA analog signal proportional to the KW to the plant PLC System. Provide terminals in the switchboard for this wiring.

4. The power monitor shall be a Square D Power Meter Model PM850.

C. Surge Protective Device:

1. A surge protective device (SPD) shall be furnished and installed in the switchboard. The surge suppressors shall be UL 1449 Second Edition Listed (1998). Unit shall protect all modes (L-L, L-N, L-G, N-G) applicable. Unit shall have 240kA of surge capacity per phase with a let-thru voltage of less than 1500V L-L and 700V L-G. A disconnecting means shall be provided ahead of the surge suppressor so the unit can be serviced without de-energizing the service.

2. Surge suppressor shall have AC tracking filter with EMI/RFI filtering. Each module shall be fused individually, thermally protected, and have LED indication.

3. The SPD shall be furnished with a dry alarm contact to indicate any module failure. This contact shall be wired to terminals in the switchboard for wiring to the plant PLC System.

4. The SPD shall be provided and installed by the switchboard manufacturer. Surge suppressor shall be Square D.

D. Main Breaker:

1. Main circuit breaker shall be solid state individually mounted and identified. Circuit breaker shall be 100% rated and shall have quick-make, quick-break mechanism and shall visually indicate whether the breaker is closed, open or tripped.

2. The main breaker shall have sufficient interrupting capacity to properly close against and interrupt instantaneously, without damage, the maximum short circuit current available at the breaker. Minimum interrupting capacity shall be 65,000 amperes symmetrical at 480 volts. Provide mechanism for locking in the "off" position.

3. The breaker shall include adjustable long time, short time, and instantaneous trip settings.

4. The main breaker shall be furnished with GFI protection.

E. Automatic Transfer Switch:

1. Furnish a 1600 amp, 480 volt, 4-pole, 4-wire automatic transfer switch in Main Distribution Switchboard for utility and generator service. The transfer switch shall be suitable for continuous operation and shall consist of a double throw power transfer mechanism and a microprocessor controller. Provide lugs in the MDS for the transfer switch wiring.

2. The transfer switch shall be arranged to close a contact for remote starting of the emergency generator, after a time delay of 0-6 seconds, after power failure or drop in any phase voltage to 70 percent of line voltage. During the delay period, the load circuits shall not be disconnected from the normal service lines.

3. When the generator is delivering not less than 95 percent of rated voltage and frequency, the load circuits shall be transferred. Retransfer to normal service shall be automatic when full line voltage and phase are restored after a time delay of 0 to 5 minutes, set for 3 minutes. Provisions shall also be made for manual transfer to the generator. After transfer to normal source, the generator shall continue to run for 5 minutes (adjustable 0 to 25 minutes) unloaded, shall shut down and shall be ready to start upon the next failure of the normal source or for manual start-up. If the generator should fail while carrying the load, retransfer to the normal source after a short delay shall be made upon restoration of the normal power. The pick-up and drop-out settings of the phase voltage-sensing relays shall be completely adjustable in the field from 70 percent to 100 percent pick-up and drop-out.

4. The transfer switch shall be double-throw switch operated by a single coil mechanism momentarily and electrically. Operating current for transfer shall be obtained from the source to which the load is to be transferred. Failure of any coil or disarrangement of any parts shall not permit a neutral position. The switch shall be positively locked mechanically on either source without the use of hooks, latches, semi-permanent magnets, or contacts. All contacts and coils shall be readily accessible for replacement from the front of the panel without major disassembly of associated parts.

5. The transfer switch shall be equipped with a test button, and auxiliary contacts as required to show that the switch is in the normal or emergency position. Provide pilot lights on the MDS door

to indicate the switch position.

6. Auxiliary contacts shall be provided for remote indication of the transfer switch position. These contacts shall be wired to a terminal block in the transfer switch for wiring to the PLC System.

7. The transfer switch shall have a load test switch to simulate normal power failure.

8. The transfer switch shall be furnished with an inphase monitor.

9. Provide a 7-day solid-state exercise clock to set the day, time and duration of the generator exercise period. Furnish a selector switch to enable the generator to be exercised with or without load.

10. Minimum withstand and closing ratings shall be in accordance with UL 1008.

11. The automatic transfer switch shall be ASCO 7000 Series.

12. The automatic transfer switch shall be furnished with all software, programs and cables necessary for maintenance and adjustment of the transfer switch.

F. Power Circuit Breakers:

1. The circuit breakers shall be Square D Masterpact NW and/or NT Low Voltage Power Circuit Breakers, or equal, and shall be listed to UL 489.

2. Circuit breakers shall be suitable for the required instantaneous rating without the use of current limiting fuses.

3. All circuit breakers shall have field interchangeable electrical accessories including shunt trip, spring release, electrical operator, auxiliary contacts, and Trip Unit.

4. All secondary connections shall be made directly to the front of the circuit breaker cradle.

5. Each Circuit breaker shall have built in contact temperature and contact wear sensors.

6. Padlocking provisions shall be furnished to receive up to three padlocks when circuit breaker is in the disconnected position, positively preventing unauthorized closing of the circuit breaker contacts.

7. Provisions for up to two key locks shall be furnished allowing locking in the disconnected position. Provisions for locking in the connected, test and disconnected positions by padlock or key lock shall be provided.

8. Located on the face of the circuit breaker shall be buttons, with optional lockable clear cover, to open and close the circuit breaker and indicators to show the position of the circuit breaker contacts, status of the closing springs, and circuit breaker position in the cell. An indicator shall show “charged–not OK to close” if closing springs are charged but circuit breaker is not ready to close. Circuit breaker racking system must have positive stops at the connected, test, disconnected and withdrawn positions.

9. Circuit breakers must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground contact check between the circuit breaker and cell when the accessory cover is removed while the circuit breaker is in the connected, test or disconnected positions.

10. Circuit breakers shall provide long service life under service in a wastewater treatment facility.

11. Trip Units:

    a. Circuit breaker trip system shall be a MICROLOGIC electronic trip unit.

    b. All trip units shall be removable to allow for field upgrades.

    c. Trip Units shall incorporate “True RMS Sensing”, and have LED long-time pickup indications.

    d. MICROLOGIC trip unit functions shall consist of adjustable long-time pickup and delay, short-time pickup and delay, instantaneous and ground-fault pickup and delay.

    e. Adjustable long-time pickup (Ir) and delay shall be available in an adjustable rating plug that is UL Listed as field-replaceable. Adjustable rating plug shall allow for nine long-time pickup settings from 0.4 to 1 times the sensor plug (In). Other adjustable rating plugs shall be available for more precise settings to match the application. Long-time delay settings shall be in nine bands from 0.5–24 seconds at six times Ir.

    f. Short-time pickup shall allow for nine settings from 1.5 to 10 times Ir. Short-time delay shall be in nine bands from 0.1–0.4 I2 t ON and 0–0.4 I2 t OFF.

    g. Instantaneous settings on the trip units with LSI protection shall be available in nine bands from 2 to 15 times In. The Instantaneous setting shall also have an OFF setting when short-time pick-up is provided.

    h. All trip units shall have the capability for the adjustments to be set and read locally by rotating a switch. Trip units shall have the capability to electronically adjust the settings locally and remotely to fine increments below the switch settings. Fine increments for pickup adjustments are to be one ampere. Fine increments for delay adjustments are to be one second.

    i. Trip unit shall provide local trip indication and capability to indicate local and remote reason for trip, i.e., overload, short circuit or ground fault.

    j. Ground-fault protection shall be available for solidly grounded three-phase, three-wire or three-phase, four-wire systems. Trip unit shall be capable of the following types of ground-fault protection: residual, source ground return, and modified differential. Ground-fault sensing systems may be changed in the field.

    k. Ground-fault settings for circuit breaker sensor sizes 1200 A or below shall be in nine bands from 0.2 to 1.0 times In. The ground-fault settings for circuit breakers above 1200 A shall be nine bands from 500 to 1200 A.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Concrete Base:

1. Switchboard shall be installed on a concrete pad.

B. Identification:

1. An engraved laminated black plastic nameplate with white letters shall be provided and installed for each breaker indicating circuit it protects, and for all components located inside the enclosure. All wiring inside the enclosure shall be labeled.

**3.2 SWITCHBOARD SETTINGS**

A. Adjustment of Breaker Settings:

1. Contractor shall have a factory-authorized representative present to adjust the trip settings on each circuit breaker in accordance with the recommendations of the short circuit/coordination study. All breaker adjustments shall be performed in the presence of the Owner.

**3.3 TESTING AND TRAINING**

A. Testing:

1. Contractor shall have a factory-authorized representative present with required test equipment to test the ground fault protection devices and explain operation in the presence of the Owner and also submit results of test in writing.

B. Training:

1. Provide four (4) hours of training for the Owner on the switchboard including operation of circuit breakers, power monitors, and surge protective devices. Training shall be performed by a manufacturer's representative.

**END OF SECTION 26 24 13**

# SECTION 26 32 13

# EMERGENCY GENERATOR SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish a complete diesel emergency generator system including generator, prime mover, muffler, exhaust system, cranking battery, battery charger, control panel, sub-base fuel tank, water jacket heater, generator mounted circuit breaker, Level 2 sound attenuated weatherproof enclosure, and all other necessary material required to complete the system.

2. The Contractor shall provide all diesel fuel required for the testing and start-up of the generator. Following the completion of the generator start-up and testing, the Contractor shall fill the generator sub-base tank with diesel fuel.

B. Generator Requirements:

1. The emergency generator shall be rated for continuous standby service at 750 KW, 937.5 KVA, 60 Hz, 0.8 power factor, 277/480 volts, 3 phase, 4 wire.

2. The generator must meet the most current EPA emission requirements for this size generator at the time of manufacture.

### 1.2 QUALITY ASSURANCE

A. Standards: The engine generator set, and all accessories, shall meet the requirements of:

| | |
|---|---|
| MIL-STD | 705 B |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturer's Association |
| NFPA | National Fire Protection Association (Pamphlets 30, 31, 37, 110) |
| UL | Underwriters' Laboratory |

B. Quality Control:

1. All components of the emergency generator system shall be new and of the most current and proven design.

2. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency system conditions.

3. This generator set system shall be assembled, tested and shipped by one supplier so that there is one source of supply and responsibility.

4. The Supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48 hours of placing the order. The Supplier shall employ a manufacturer trained and certified technician on a full time basis at the service facility capable of making repairs and responding to service calls within 24 hours of notice. Certified proof of this requirement shall be available from the Supplier.

C. Testing:

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required below. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and shall document the following:

   a. Maximum power level
   b. Maximum motor starting capacity
   c. Voltage dip
   d. Fuel consumption
   e. Engine-generator cooling air flow
   f. Governor response time
   g. Alternator temperature rise per NEMA MG1-22.40
   h. Harmonic analysis and voltage Wave Form Deviation per MIL-STD-705 B, method 601.4
   i. Three (3) phase short circuit test for mechanical and electrical strength

2. Factory tests of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory. The manufacturer shall successfully test the generator set to be supplied, document items 1 a-I above and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall be performed and the results submitted before shipping the generator set.

D. Acceptance Tests:

1. Acceptance testing of the installed generator set shall be conducted by a factory-trained representative of the generator set manufacturer. An authorized representative of the Owner shall witness the acceptance tests. The test results shall be submitted to and approved by the Owner before the generator set is accepted. The Supplier shall furnish all testing equipment, materials, etc., including fuel needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Supplier shall be corrected and, if warranted or requested by the Owner, the test shall be re-performed prior to acceptance. Final 0&M Manuals shall be submitted before the acceptance tests commence.

2. The acceptance tests shall be performed during an eight-hour field test during which the manufacturer's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test, performed in accordance with NFPA 110 section 5-13.2. The load tests shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator. Salt-water brine tank load banks are not acceptable for this purpose and are disallowed and will not be utilized for this test.

E. Warranty:

1. The emergency generator shall be furnished with a 5-year warranty.

**1.3 SUBMITTALS**

A. Shop Drawings:

1. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Shop drawings shall include manufacturer's literature and complete information including the following:

a. Engine generator system plan, elevation and dimensional drawings clearly indicating all aspects of the system including points for each of the inter-connections required.

b. Engine generator/exciter control cubicle layout and component descriptions.

c. Sub-base fuel tank, piping schematic and fuel line connection information.

d. Fuel consumption rate curve at various loads, ventilation and combustion CFM requirements.

e. Exhaust muffler and vibration isolator.

f. Schematic ladder and control wiring diagrams for the generator system.

g. Printed literature and brochures describing the system including all sizing requirements and components specified.

h. The weight of the engine, generator and complete system.

i. Points of measurement and maximum vibration readings (measured as velocity) for the installed system recommended by the manufacturer.

j. Battery, battery rack and battery charger literature and description.

k. Sound attenuated weatherproof housing.

l. The specified standby KW of the generator shall be for continuous electrical service during interruption of the normal utility power source and this shall be certified to this effect by the manufacturer for the actual unit supplied.

m. Factory prototype test results performed on a unit of this size and type documenting items (a) through (I) listed in 1.02 C above.

B. Operation and Maintenance Manuals:

1. Submit required number of copies of an operation and maintenance manual for the complete emergency generator system. The manual shall be submitted in 3-ring loose-leaf binders, and shall be complete, neat, orderly and indexed. The manual shall include, at the least, all data bearing on the specific generator system necessary for maintenance, operation, parts repair and replacement including all accessories and electrical controls, fire-code safety and operator safety measures, and lubrication schedule. A copy of the approved shop drawings shall be included in the manual. Manual shall be submitted and approved before system will be accepted.

C. Installation Certificate:

1. A factory technician shall inspect the installed generator system and certify in writing to the installer that it is installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start-up and make recommendations to resolve any defects experienced. A copy of the installation certificate must be submitted to the Owner before the generator set is conditionally accepted.

**1.4 MANUFACTURER**

A. The manufacturer of the generator set shall be Kohler, or equal.

**PART 2 PRODUCTS**

**2.1 GENERATOR EQUIPMENT**

A. Engine:

1. The engine shall be the water-cooled in-line or V-type, compression ignition diesel. It shall meet specifications when operating on No. 2 diesel fuel. The engine shall be equipped with filters for fuel, lube oil, intake air, lube oil cooler, fuel transfer pump, fuel priming pump, one foot of flexible fuel line between engine and rigid supply, and gear-driven water pump.

2. The engine shall be controlled by an electronic governor. The governor shall maintain isochronous frequency regulation from no load to full load.

3. The engine shall be equipped with automatic safety controls, which will shut down the engine in the event of low oil pressure, high water temperature, overspeed and overcrank.

4. The engine shall be remote starting with a 2 wire, solenoid shift electric starter.

B. Generator:

1. The generator shall be a three phase, single-bearing, synchronous-type built to NEMA standards, rated for continuous standby at service. Class F insulation shall be used on the stator and rotor, and both shall be further protected with 100% epoxy impregnation and an overcoat of resilient insulating material on end coils to reduce possible fungus and/or abrasion deterioration. The generator shall incorporate a resettable thermal protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step.

2. A generator-mounted, volts-per-hertz type exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be ±1% from no load to full rated load. Voltage level adjustment shall be a minimum of ±5%. The solid-state regulator module shall be shock-mounted and epoxy-encapsulated for protection against vibration and atmospheric deterioration. Voltage dip due to motor starting current shall not exceed 20% under the maximum load conditions.

3. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system over current devices.

4. The alternator shall be 105°C rise at standby rating.

C. Cooling System:

1. The engine shall be furnished with a cooling system having sufficient capacity for cooling the engine when the generator set is delivering full rated load at an ambient temperature of 125°F.

2. The engine cooling system shall be filled with a solution of 50% ethylene glycol. Cooling system shall be pretreated by supplier for inhibition of internal corrosion.

3. The engine shall be equipped with a radiator having a blower type fan. The radiator shall have a duct adapter flange, and shall be equipped with a fan guard and core guards.

D. Starting System:

1. The engine shall be equipped with a DC electric starting system of sufficient capacity to crank the engine at a speed, which will allow full diesel starting of the engine. The motor voltage shall be as recommended by the engine manufacturer.

2. Fully automatic generator start/stop controls shall be provided in the generator control panel to start the generator automatically from a contact in the automatic transfer switch.

3. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent re-cranking for a definite time after source voltage has reduced to a low value. If engine fails to start, or any safety device operates while engine is running, engine shall be stopped immediately and starting control locked out, requiring manual resetting.

4. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed and overcrank. Controls shall include a 10-second cranking cycle limited to 3-5 attempts before lockout.

5. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage. Relays shall be equipped with silver-gold contacts of the wiping type and shall have adequate pressure to insure reliable performance at battery voltage.

6. Batteries:

a. A lead/acid storage battery set of the heavy-duty starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated for a minimum of 172 hours and shall be of sufficient capacity to provide for 1½ minutes total cranking time without recharging. It shall be sized for the cold cranking amps as recommended by the battery manufacturer. A wood bottom, fiberglass treated, battery rack and necessary cables and clamps shall be provided. The battery rack shall be isolated from the engine to protect it from excessive vibration, and shall be readily accessible for service and/or removal.

7. Battery Charger:

a. A 10-amp current limiting battery charger shall be furnished to automatically recharge the batteries. The charger shall include overload protection, silicon diode-full wave rectifiers, voltage surge suppressors, DC ammeter, and AC over current protection. AC input voltages shall be the same as the generator output voltage.

b. The battery charger shall be mounted inside the generator housing.

E. Jacket Water Heaters:

1. Provide engine mounted thermostatically controlled water heaters to maintain the engine jacket water temperature at 100°F. Heater shall be sized as recommended by the manufacturer.

2. The heaters for the generator shall operate on 480 volts, 1 phase.

F. Sub-base Fuel Tank:

1. Furnish and install a sub-base fuel tank under the generator. The fuel tank shall be sized to run the generator for 24 hours at 100% load. The minimum size of the fuel tank shall be 2,000 gallons.

2. Tank shall be double wall construction, with a float switch between walls. Float switch shall be wired to an alarm light on the generator control panel.

3. Tank shall have a fuel level gage mounted next to fill pipe.

4. Tank shall have a low fuel level float switch, which shall be wired to an alarm light on the generator control panel.

5. Fill and vent pipes shall be as recommended by manufacturer, and installed by the Contractor.

6. Exact location of fill pipe and vent shall be coordinated with Owner.

7. All fuel connections at the engine shall be made using wire reinforced flexible hose.

8. Contractor shall fill the fuel tank with diesel fuel prior to final acceptance.

G. Exhaust System:

1. Provide a critical type exhaust silencer, including stainless steel flexible exhaust fitting, properly sized according to the manufacturer's recommendation. Exhaust pipe size shall be sufficient to ensure that exhaust backpressure does not exceed the maximum limitations specified by the generator set manufacturer. The silencer shall be manufactured by Maxim, or equal.

2. Provide taps for drainage with petcock drain valves, drip cap, rain cap, wall thimble and accessories.

3. The exhaust silencer shall be installed inside the generator housing.

4. The exhaust piping and muffler shall be insulated with insulating blankets.

H. Engine Generator Set Mounting:

1. The engine generator shall be mounted in perfect alignment on an all welded preformed structural steel I-beam or C channel skid type sub-base which shall provide for attachment of all specified engine and generator accessories.

2. Provide spring-type vibration isolators for mounting between the engine generator set mounting rails and the sub-base fuel tank. The size and quantity of isolators shall be as recommended by the manufacturer.

I. Generator Control Panel:

1. Provide a generator-mounted NEMA 12 control panel. The control panel shall be mounted on the generator terminal box and shall be vibration isolated. The generator control panel shall contain, but not be limited to, the following equipment:

   a. Digital AC Voltmeter
   b. Digital AC Ammeter
   c. Digital AC Frequency Meter
   d. Ammeter - Voltmeter Phase Selector Switch
   e. Automatic Starting Controls
   f. Voltage Level Adjustment Potentiometer
   g. Run-stop-remote switch and remote start-stop terminals
   h. Alarm lights for low oil pressure, low engine temperature, high water temperature, overspeed, overcrank, low fuel tank level and fuel tank leak
   i. Engine Temperature and Pressure Gauges
   j. DC Charging Volts and Ampere Gauges
   k. Running Time Meter
   l. Dry Contacts for run indication, not in auto, low fuel tank level, fuel tank leak, and common alarm wired to terminal strips
   m. Panel illumination lights and switch

J. Generator Circuit Breaker:

1. A main line molded case 3-pole circuit breaker shall be installed as a load circuit interrupting and protection device. It shall operate both manually as an isolation switch and automatically during overload and short circuit conditions.

2. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. The circuit breaker shall meet standards established by Underwriters' Laboratories, National Electrical Manufacturer's Association, and National Electrical Code.

3. The circuit breaker shall be mounted in a NEMA 12 type enclosure, adjacent to the generator control panel.

K. Sound Attenuated Enclosure:

1. Provide a weatherproof, sound attenuated 16 gauge aluminum enclosure for the generator. The enclosure shall be drip-proof to prevent water from entering enclosure and shall be provided with heavy-duty “lockable” latches to ensure tamper-proof security and safety. Sound shield shall be provided with lifting eyes for ease of installation.

2. The enclosure shall have solid access doors with door handles keyed alike. Doors shall have 3-point latches, stainless steel butt hinges, stainless steel door holders, and rain gutters above doors.

3. The enclosure shall have an advanced sound-attenuation design. The noise at 7 meters shall be 73 dBA or less, at full load.

4. Provide a minimum of four (4) lights inside the enclosure to illuminate the generator.

5. Provide a 20 amp 120 volt, weatherproof, G.F.I. receptacle on each side of the generator enclosure.

L. Generator Load Center:

1. Provide a 100 amp 120/208 volt, 1 phase load center inside the generator enclosure to power the 120 volt and 208 volt generator circuits. The load center shall have a 50A-2P main breaker and four (4) 20A-1P circuit breakers.

2. The generator enclosure receptacles, jacket water heater, and battery charger shall be powered from the load center.

M. Painting:

1. The complete generator set shall be painted with the manufacturer's standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

**PART 3 FIELD SERVICES**

**3.1 TECHNICAL SERVICES**

A. The manufacturer of the emergency generator shall furnish a qualified technician, whose qualifications are acceptable to the Owner, to provide the following services:

1. Inspection of the installation of the emergency generator system

2. Start-up

3. Performance testing

4. Operating adjustments

5. Instruction of Owner's personnel

6. Assistance at final inspection.

B. These services shall include not less than four (4) 8-hour workdays on-site comprising a minimum of four trips.

**END OF SECTION 26 32 13**

# SECTION 26 50 00

# LIGHTING FIXTURES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish all labor and materials to complete lighting fixture installation and associated items indicated on the drawings and specified herein.

2. Fixtures of size and type specified herein shall be supplied, installed and connected as indicated on the Drawings. Provide accessories for each fixture as required for a complete installation.

3. Furnish and install lamps in each fixture.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

1. Fixtures shall be U.L. listed.

2. All fixtures shall meet all Federal, State and local required criteria.

3. All light fixtures shall be mounted in accordance with manufacturer's recommendations.

4. Ballasts shall be Electrical Testing Laboratories, Inc. (E.T.L.) - Certified Ballast Manufacturers Association (C.B.M.) certified.

5. The installation must comply with the amended National Electrical Code of the National Fire Protection Association.

B. Qualification:

1. Provide manufacturer specified for each light fixture type. Substitutes will not be accepted without approval prior to the bid.

2. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of each fixture; including ballast information, construction details, light distribution details and/or coefficients.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. LED Drivers:

1. LED light driver shall be of high efficiency.

2. LED light driver shall allow continued operation of all other LEDs in the event of an LED failure.

B. Light Fixture Schedule:

1. CA: Ceiling mounted, 120 volt, low profile high efficiency LED, nominal 8" x 4', totally enclosed gasketed fixture suitable for wet locations. Fixture shall be provided with an electronic driver. Fixture shall produce a minimum of 6,000 initial lumens and have a color temperature of 4000K. Housing shall be one-piece high impact plastic to provide durability and corrosion resistance. The lens shall be one-piece, low profile, frosted acrylic, resistant to damage. Fixture shall have plastic latches to apply positive, uniform pressure on the gaskets to seal against dust and moisture. Provide gasketed conduit hubs. Fixture shall be Holophane #EMSL48-6000LM-LPAFL-MD-MVOLT-40K-80CRI-WLFEND2 or Lithonia #FEM-L48-6000LM-LPAFL-MD-MVOLT-40K-80CRI-WLFEND2.

2. SA: Pendant mounted, 120 volt, low profile high efficiency LED fixture. The fixture shall produce a minimum of 10,000 initial lumens and have a color temperature of 4000K. The fixture housing shall be constructed of die-cast copper-free aluminum with corrosion resistant, gray epoxy powder finish. Fixture shall have a prismatic glass reflector and shall be UL listed as suitable for wet locations. Fixture shall be Holophane #PXLW-10000LM-MD0-MVOLT-40K-80CRI-PM-CR-DGXD.

3. WA: Wall mounted, 120 volt, high efficiency LED fixture. The fixture shall produce a minimum of 8000 initial lumens and have a color temperature of 4000K. The fixture housing shall be constructed of die-cast copper-free aluminum with a bronze powder coated finish. Fixture shall have a tempered glass lens. Fixture shall be Holophane #W4GLED-30C1000-40K-T3M-MVOLT-SPD-BZSDP.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Installation:

1. Contractor shall furnish supports for light fixtures. Light fixtures shall be supported with formed channels, angles, rods, clamps, washers, etc. of sufficient size and strength to support weight of fixtures from the building overhead structural members, independently from the ceiling system.

2. The fixture manufacturer's catalog numbers describing the various types of fixtures shall be used as a guide only and do not include all the required accessories or hardware that may be required for a complete installation. The Contractor shall be responsible for furnishing, at no additional cost to the Owner, all the required accessories and hardware for a complete installation.

3. Contractor shall adjust the angle of all flood lights in the field to obtain optimum illumination.

4. All inoperable lamps shall be replaced with new lamps during the course of construction, up to and including the date of final acceptance by the Owner and Engineer.

**END OF SECTION 26 50 00**

# SECTION 26 52 00

# BATTERY EMERGENCY LIGHTING FIXTURES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Furnish, install and connect a complete system of conduits, conductors, unit type battery emergency lighting fixtures and all other materials and equipment necessary for the installation of an emergency lighting system.

### 1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications:

| | |
|---|---|
| FM | Factory Mutual Engineering Corp. |
| NEC | National Electrical Code of National Fire Protection Association |
| UL | Underwriters' Laboratories |

B. Qualification:

1. The complete system shall be of a type, which has been in satisfactory service for at least one year under automatic emergency lighting conditions.

2. Provide manufacturer specified for each fixture type. Substitutes will not be accepted without approval prior to the bid.

3. When more than one name of manufacturer of fixture is listed in these specifications, the first manufacturer and number determine the style and quality.

### 1.3 SUBMITTALS

A. Shop Drawings:

1. Submit manufacturer's latest publication of the following:

a. Battery Emergency Light Fixtures
b. Fixed Heads
c. Remote Heads
d. Combination Battery Unit/Exit Fixtures
e. Battery Exit Fixtures

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Battery Emergency Light Fixtures:

1. EA/EAR: Battery emergency light fixtures shall have a nonmetallic housing. Fixture shall be provided with a test switch, status indicator and a rechargeable Nickel Cadmium battery. The battery shall provide 90 minutes of emergency illumination. Fixture shall operate on 120 volts and shall be furnished with two 2-watt LED lighting heads.

Fixture shall be Holophane #DM30-WL-LED or Crouse-Hinds #N2LPS12222. Battery emergency remote heads shall be Holophane ELA-QM-T-L0309 or Crouse-Hinds #N2RF1222.

B. Combination Battery Unit/Exit Fixtures:

1. EB: Combination exit fixture/battery emergency units shall be back mounted, single faced with red (confirm color with local code) high intensity LED lamps and sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power. Fixture shall be Holophane Magellan #QM-LED-R-HO-SD or Sure-Lites #LPX7DHNCl.

C. Exit Fixtures:

1. EC: Exit fixtures shall be back mounted, single faced with red high intensity LED lamps and a sealed nickel cadmium battery. The fixture housing shall be white polycarbonate. The exit fixtures shall operate on 120 VAC power and shall be Holophane Magellan #QM-R-HORO or Sure-Lites #LPX7.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Battery Unit:

1. Battery emergency lighting fixtures shall be firmly fastened to walls. Mounting height to be determined in the field.

B. Wiring:

1. Wiring on low voltage side of unit shall be no smaller than #10.

2. Connect battery emergency lighting fixtures and exit fixtures to lighting circuit for area being protected ahead of all local control switches.

**END OF SECTION 26 52 00**

# SECTION 26 60 00

# HEAT TRACING AND PIPE INSULATION

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included:

1. Provide heat tracing and insulation of piping systems as specified herein and indicated on the Drawings.

2. Furnish and install temperature controllers, junction boxes, conduit, enclosures, tape wrap, pipe insulation, final connections and warning sign.

3. Provide complete pipe heat tracing and insulation systems; furnish and install all materials and equipment not specified or detailed on the Drawings but necessary for complete installation and proper operation of the work described or implied.

### 1.2 QUALITY ASSURANCE

A. Industry Standards and Regulations: Provide and install products conforming with the applicable requirements of:

| | |
|---|---|
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories |

B. Reference Standards:

1. Federal Specifications (FS):

a. FS HH-I-1751/3A - Insulation Sleeving, Thermal Pipe Covering (Cellular Glass)

### 1.3 SUBMITTALS

A. Shop Drawings and Product Data:

1. Submit detailed installation shop drawings for each component of system; show complete information concerning fabrication, installation, and wiring diagram.

2. Submit manufacturer's latest published literature for heating cable, pipe insulation, temperature controllers, and equipment enclosures.

### 1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver products to the job site in their original unopened, factory-packaged parcels clearly labeled with the manufacturer's name, product description, type, class and rating and including the manufacturer's installation instructions.

B. Store insulating materials in enclosed, dry and ventilated areas. Store on pallets or blocking at least 6" above the floor or earth, with sufficient support to prevent sheets, panels and shapes from warping or distorting. Protect from physical damage.

## PART 2 PRODUCTS

### 2.1 HEATING CABLE

A. The heat trace element shall be a self-regulating type cable consisting of two bus wires linked by a conductive polymer core. The heat trace cable shall vary its output power all along its length to respond to temperature. Cable shall be rated 3 watts/foot, 5 watts/foot or 8 watts/foot as required for each specific application. Heating cable shall be Tyco Thermal Controls Raychem Type BTV-CT. or equal.

B. The cable shall be capable of being crossed over or cut in the field.

C. Where installed on nonmetallic pipe the heater shall be installed using an aluminum tape.

D. Maximum temperature of heat tracing shall not exceed 150°F.

E. Suitable for operation at the voltages indicated without modification or additional transformation; capable of being field cut to length as required.

F. Heat tracing shall keep pipe at 40°F at an ambient temperature of -10°F; normal temperature of liquid in pipe is 50°F.

### 2.2 TERMINATION KITS

A. Accessories and materials required to install and terminate heating cable as indicated on the Contract Drawings and in accordance with the manufacturer's recommendations; include all start-up and field test instructions.

### 2.3 TEMPERATURE CONTROLLERS

A. Ambient sensing, thermostat type, temperature controller assembly; suitable for voltages indicated.

1. Switch Contact Rating: 22 amps @ 120-240 VAC
2. Switch Action: SPST, 120 VAC, Open on temperature rise
3. Temperature Range: 15 to 140°F
4. Setpoint: 40°F
5. Differential: 6°F

B. Thermostat shall be Chemelex Type AMC-lA, or equal.

C. Mount in a weatherproof NEMA 4X housing.

### 2.4 PIPE INSULATION

A. Molded, high temperature, abuse-resistant pipe insulation composed of hydrous calcium silicate. Pipe insulation shall be Johns Manville Thermo-12 Gold, or equal

1. Meets or exceeds ASTM C 533, Type 1 physical property requirements.
2. 11/2” thick unless otherwise indicated on the contract drawings.
3. Furnish prefabricated fitting covers for valves, flanges, and fittings of same material and thickness as specified for pipe insulation; covers to be removable and capable of being reinstalled without damaging insulation material.

B. Pipe, Valve and Fitting Insulation Jacket: Provide a smooth aluminum jacket over all pipe insulation; aluminum shall be ASTM B209 Temper H14 with a minimum nominal thickness of 0.016".

## PART 3 EXECUTION

### 3.1 REQUIREMENTS

A. Where heat tracing is indicated, provide heating cable for aboveground piping, including valves and fittings.

B. Provide pipe insulation as indicated on the Contract Drawings and as specified.

### 3.2 INSTALLATION - HEAT TRACING

A. Install pipe heat tracing systems as recommended by the heating cable manufacturer and as required by Article 427 of the National Electric Code.

B. Secure heating cable to pipe and fittings using glass tape.

C. Provide cables entering junction boxes or temperature controller enclosures with waterproof entry seals or effectively waterproof with a non-hardening silicone sealant.

D. Provide warning labels spaced at maximum 20' intervals on exterior of pipe insulation; labels shall be waterproof, conspicuously colored, with lettering "CAUTION - Electrically Traced Line".

E. Set temperature controllers to provide freeze protection to maintain heat traced piping at minimum temperature of 40°F.

### 3.3 INSTALLATION - PIPE INSULATION

A. Apply pipe insulation to clean, dry surfaces in staggered joint fashion with joints tightly butted and buttered with joint sealant; secure insulation to pipe with glass reinforced tape lapped approximately 50% and spaced on maximum 6" centers.

B. Apply prefabricated fitting covers for valves, flanges and fittings in accordance with manufacturer's instructions.

C. Apply aluminum jacketing to exterior piping, valves and fittings with minimum 2" wide side and end laps; outer edge of side lap turned under 1" to provide a smooth edge. Position laps to shed water. Seal seams and laps with a waterproof coating. Secure jacketing in place with 1/2" wide aluminum bands spaced on maximum 6" centers.

D. Carry exterior pipe insulation and jacket to at least 3'-6" below finished grade.

**END OF SECTION 26 60 00**

# SECTION 31 11 00

# CLEARING AND GRUBBING

## PART 1 GENERAL

### 1.1 SUMMARY

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for clearing, grubbing, removing and disposing of all vegetation and debris (including earthen materials incidentally removed with vegetation and debris), and removing structures and obstructions located within the limits shown on the Drawings or designated by the ENGINEER, except such objects as are designated to remain in place or are to be removed in accordance with other sections of these Specifications. The WORK shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

## PART 2 PROJECTS - NOT USED

## PART 3 EXECUTION

### 3.1 DESCRIPTION

A. The ENGINEER will establish the limits of the WORK and will designate all trees, plants, shrubs and other items to remain. The CONTRACTOR shall protect and preserve all items designated to remain.

B. Miscellaneous trimming of trees or shrubs designated to remain shall be conducted when directed by the ENGINEER. Trimming shall be in accordance with good tree surgery practice.

C. All vegetation and debris to be removed shall be disposed of by the CONTRACTOR within areas indicated on the Drawings or areas approved by the ENGINEER. When burning is permitted, it shall be under the constant care of competent employees. Burning shall be performed in a manner such that anything designated to remain on the right-of-way, the surrounding forest cover, or other adjacent property will not be jeopardized. Burning shall be done in accordance with all applicable laws and ordinances. The CONTRACTOR shall obtain all required permits.

D. The CONTRACTOR is responsible for:
   1. Securing waste disposal sites,
   2. Obtaining written permission of the owner of the disposal site and
   3. Securing any required permits, if none is indicated on the Drawings.

   The cost of securing such sites shall be borne by the CONTRACTOR. If requested by the ENGINEER, the CONTRACTOR shall furnish the permit numbers of all required permits for disposal sites.

E. Merchantable timber within the clearing limits will become the property of the

F. CONTRACTOR, unless otherwise specified.

### 3.2 GRUBBING

A. All trees, stumps, roots and other objects not designated to remain shall be cleared and grubbed. If the area is not to be benched, the removal of undisturbed stumps and roots and nonperishable solid objects that will be a minimum of four feet below the embankment surface and that do not extend more than six inches above the original ground line, will not be required.

B. In areas outside of the grading limits of cut and embankment areas and to the established limits of the WORK, all stumps and nonperishable solid objects permitted to remain in place shall be cut off not more than six inches above the ground line or low water level.

C. Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable materials and compacted in accordance with the

D. Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable materials and compacted in accordance with Contract Documents.

**3.3 HAND CLEARING**

A. In areas where Hand Clearing is indicated on the Drawings or designated by the ENGINEER, no equipment on wheels or tacks shall be used. Care shall be taken to insure that the grass, moss cover, or the natural ground is not disturbed. Stumps shall be cut flush with the ground, except that in areas within four feet or more of embankment cover, stumps may be cut off six inches above the natural ground.

**3.4 SELECTED TREE REMOVAL**

A. Trees designated by the Engineer, outside of the normal clearing and grubbing and/or hand clearing limits, shall be removed and disposed of in accordance with this Section. Trees to be removed may be designated by the ENGINEER at any time during the performance of the contract, and may be subject to the conditions specified under Hand Clearing. Trees designated for selective removal shall be cut off within six inches of the ground.

**3.5 REMOVE AND RELOCATE BUSH OR TREE**

A. Bushes or trees shown on the Drawings for removal and relocation shall be removed and relocated as directed by the ENGINEER.

B. Bushes and trees designated for removal and relocation shall be carefully removed with enough of the root wad kept intact to ensure the survival of the bush or tree in its new locations. Bushes and trees designated for removal and relocation that are damaged, or that do not survive as a result of the transplanting, shall be replaced by the CONTRACTOR at its expense. The relocated bush or tree shall be placed to original depth at a location within 15 feet of the original location, as directed by the ENGINEER.

**END OF SECTION 31 11 00**

# SECTION 31 14 00

# EARTH STRIPPING AND STOCKPILING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Stripping of topsoil within limits indicated.

### 1.2 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; 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 more than 2-inches in diameter; and free of weeds, roots, and other deleterious materials.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Remove trash, debris, weeds, roots, and other waste materials.

D. Stockpile topsoil materials designated to remain on site at a location approved by the Owner at a location away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

E. Do not stockpile topsoil within drip line of remaining trees.

### 3.2 DISPOSAL

A. Remove surplus soil material and unsuitable topsoil, and legally dispose of them off the Owner's property.

**END OF SECTION 31 14 00**

# SECTION 31 20 00

# EARTHWORK

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Work Of This Section Includes, but is not limited to:
   1. Excavation and Backfill for Structures
   2. Dewatering
   3. Sheeting and Shoring
   4. Site Grading

B. Trench excavation required by Mechanical or Electrical Contractors and not required for placement of building foundations shall be performed by the Contractor in need of trench excavation.

C. Related Work Specified Elsewhere:
   1. Section 31 22 19 - Finish Grading and Seeding
   2. Section 31 23 16 - Trenching, Backfilling and Compacting
   3. Section 31 23 19 - Dewatering
   4. Section 31 50 00 - Excavation Support

D. Definition:
   1. Geotechnical Engineer - An individual registered in the project state as a Professional Geotechnical Engineer or, if the project state has no such registration category, as a Professional Engineer trained and experienced in the application of earth sciences relating specifically to soils engineering.

### 1.2 Quality Assurance Inspection

A. Special Inspection Services:
   1. A Geotechnical Engineer and qualified independent testing agency or agencies will be under Contract to Contractor during construction of this project on a periodic basis for observation of earthwork activities and performance of in-place soil testing and laboratory testing of soil materials.

B. Responsibilities and Duties of the Contractor:
   1. Contractor shall schedule and conduct a pre-construction meeting for all parties concerned with Special Inspection to reach agreement on all issues, scheduling, and procedures.
   2. The use of Special Inspection services shall in no way relieve the Contractor of its responsibility to furnish materials and construction in full compliance with the plans and specifications or to perform Quality Control measures.
   3. The Contractor shall provide quality control measures either directly or by retaining a qualified quality control agency (or agencies) to prepare work for inspection or testing by the Special Inspection Program. The Contractor's quality control measures shall precede special inspection services.
   4. To facilitate Special Inspection Services, the Contractor shall:
      a. Secure and deliver to the project site, without additional cost, representative samples of materials it proposes to use and which are required to be tested or inspected under the Special Inspection Program.

b. Furnish such labor as is necessary to obtain and handle samples at the project or at other sources of material.
c. Provide access to work areas and furnish such incidental labor, equipment, and assistance as is deemed necessary by the Special Inspection Agency.
d. Provide 48 hours minimum advance notice of field activities requiring inspection or testing by the Special Inspection Agency.

C. Authority and Limitations of Special Inspection Agency:
1. Personnel representing the Special Inspection Agency will not act as foremen nor perform other duties for the Contractor.
2. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Owner or the Engineer for final acceptance.
3. The Special Inspection Agency is not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work, unless designated otherwise by the Engineer.
4. The Special Inspection Agency shall report all test and inspection results to the Engineer and the Contractor immediately after they are performed.
5. When it appears that any material furnished or work performed by the Contractor fails to fulfill contract requirements, the Special Inspection Agency shall report such deficiency to the Engineer, the Owner and the Contractor.

D. Contractor's Failure to Meet Contract Requirements:
1. The Owner and the Engineer reserve the right to reject any items which do not meet the requirements of the plans and specifications and will require the contractor to replace these items and bear all expenses in connection with such replacements.
2. The Contractor shall pay all costs incurred in providing additional testing and/or analysis (including architectural/engineering fees) required because of deficient test results or construction not in compliance with requirements of the Contract Documents.

E. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by the Contractor and approved by the Engineer.

F. Referenced Standards:
1. American Society for Testing and Materials (ASTM):
a. C33 Standard Specification for Concrete Aggregates
b. D698 Test for Laboratory Compaction Characteristics of Soil Using Standard Effort
c. D1556 Test for Density and Unit Weight of Soil in Place by the Sand Cone Method
d. D2922 Test for Density of Soil and Soil Aggregate in Place by Nuclear Methods
e. D5080 Test for Rapid Determination of Percent Compaction
2. Maryland Department of Transportation (MDOT)
3. International Building Code (IBC)

**1.3 REQUIREMENTS**

A. Classification of Excavation: See Section 01 00 00 - General Requirements.

B. This site may require borrow to provide proper balance of cut and fill for this site. The Contractor shall provide in his Lump Sum Bid a balanced site; no additional payment will be made for any additional fill to be brought into the site nor will there be any additional payment made for excavation of unsuitable material or removal of excess and unsuitable material from the site.

C. The locations shown for utility facilities are approximate. Proceed with caution in the areas of utility facilities and expose them by hand or other excavation methods acceptable to the utility owner.

D. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations.

E. Furnish and maintain barricades, signs and markings for excavated areas.

F. Select and install a system of dewatering to accomplish groundwater control in excavations.

G. Preserve, protect and maintain operable existing drainage ways, drains and sewers.

**1.4 SUBMITTALS**

A. General: Submit in accordance with Section 01 33 00.

B. Certificates:
1. Submit a Certificate of Compliance, together with supporting data, from the materials supplier attesting that the composition analysis of backfill materials meets specification requirements.
2. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.
3. Submit certified density testing results from the soils testing laboratory.

C. Qualification Data:
1. Submit evidence of qualifications for the testing agency.

**PART 2 PRODUCTS**

**2.1 MATERIALS – GENERAL**

A. On site or imported natural soils as approved by Geotechnical Engineer.

B. Load bearing fill is defined as earth fill or rock fill required for bearing loads imposed by structures or pavement subject to motor traffic and all earth materials necessary to raise the grade from an existing elevation or prepared foundation elevation to the finished elevation in a designated fill area which cannot tolerate settlement. All load bearing fill and backfill shall be compacted to 95% of the standard proctor maximum dry density as determined by ASTM D698.

C. Nonbearing fill for areas shall be free of roots, rock larger than 3" in size and building debris, capable of minimum compaction of 90% standard proctor density at optimum moisture content established for the soil material by ASTM D698.

**2.2 MATERIALS FOR BACKFILLING, LOAD BEARING FILLS OR EMBANKMENTS**

A. Well-graded soil aggregate mixture, consisting of inorganic on-site cut soils with rock fragments less than 3 inches nominal diameter and less than 20% by weight of the mass, less than 30% of particles finer than No. 200 sieve, liquid limits less than 50, and plasticity indices greater than 10.

B. Total content of gravel or rock fragments larger than 1/2" shall not exceed 20% by weight of the mass.

C. Backfill shall not contain topsoil, organic matter, debris, cinders, or frozen material.

**2.3 SELECT STONE FILL**

A. Stone shall be a coarse aggregate material and shall comply with AASHTO #57.

**2.4 STONE UNDER SLABS**

A. Stone shall be a coarse aggregate material and shall comply with AASHTO #57, unless otherwise shown on the Contract Drawings.

**2.5 SELECT GRANULAR MATERIAL**

A. Compacted in areas of overexcavation in load bearing areas.

B. Provide as specified in Paragraph 2.2.

**2.6 GEOTEXTILE FABRIC**

A. Geotextile fabric is to be installed under select stone fill for (stabilization and reinforcement of soil and aggregates structures). The filter cloth shall be placed over the newly exposed subgrade or over the select granular material backfill, prior to placement of select stone fill, and shall conform to the following requirements:

| Fabric Property | Test Method | Minimum Value |
|---|---|---|
| Grab Tensile Strength | ASTM D4632-86 | 315 lb. |
| Grab Tensile Elongation | ASTM D4632-86 | 12% (max) |
| Burst Strength | ASTM D3786-80 | 600 psi |
| Trapezoidal Tear Strength | ASTM D4533-85 | 113 lb. |
| Puncture Strength | ASTM D4833-80 | 145 lb. |
| Permittivity | ASTM D4491-85 | 0.05 sec-1 |
| Water Flow Rate | ASTM D4491-85 | 4.0 gal/min/sf |
| Ultraviolet Stability | ASTM D4355-84 | 70% |

Geotextile fabric to be Mirafi 600X as manufactured by Ten Cate Geosynthetic, Pendergrass, Georgia (706)693-2226.

**2.7 SOURCE OF MATERIALS**

A. Use materials for fill from this Contract if they meet the requirements specified herein. If sufficient material meeting these requirements is not available from required excavation, obtain requisite material from other sources.

B. Use only material which has been approved as to quality, location of source and zone of placement in the fill.

C. The Geotechnical Engineer has the right to reject material at the job site by visual inspection, pending sampling and testing.

**2.8 EARTHWORK EQUIPMENT**

A. The Contractor shall submit a list of the compaction equipment to be utilized on the project and the recommendations of the equipment manufacturer as to the maximum lift thickness which can be placed and the method of compaction to be used with this equipment to achieve the required compaction.

B. Lift Thickness Limitations:
   1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer's recommendations.
   2. However, if the equipment manufacturer's lift thickness recommendation is followed and the specified density is not obtained, the Contractor shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.

**PART 3 EXECUTION**

**3.1 GENERAL CONDUCT OF THE WORK**

A. Temporary haul road(s) to be used by the Contractor shall be located in approved areas; the haul road(s) shall be freely drained and shall be maintained in good condition throughout the Contract period; measures shall be taken by the Contractor to control excessive dust caused by truck traffic during dry periods.

B. The Contractor shall maintain and protect cut and filled areas at all times until final completion and acceptance of all work of the Contract; eroded areas shall be repaired and replaced by the Contractor in a satisfactory manner, with no additional payment to be made for this restoration work; the Contractor may be required to remove, at his own expense, any fill material placed outside of prescribed slope lines.

C. The Contractor shall remove, from the Project site, debris of any kind resulting from or related to his operations and shall leave the premises in a condition satisfactory to the Owner.

**3.2 PREPARATION AND LAYOUT**

A. Establish and identify required lines, levels, contours and datum.

B. Maintain bench marks, monuments and other reference points.

C. Protect trees, shrubs, lawns and other features remaining as portion of final landscaping.

D. Refer to Section 31 11 00 - Clearing and Grubbing.

**3.3 ROUGH GRADING**

A. Rough grade to uniform contours; form foundations for embankments and load bearing fills.

B. Construct the finished subgrade to vary not more than 1" above or below the elevation shown.

C. Rough grade to prevent ponding of water in any area; install temporary swales if necessary to improve surface drainage.

D. Complete embankment slopes to vary not more than 6" from the slope line shown.

E. In saturated areas indicating sponginess and instability during earth moving operations shall be excavated and prepared to receive acceptable fill materials as specified; material excavated due to unsuitability shall be removed from site.

F. Excavated subsoil materials to be used for fill materials shall be approved by Geotechnical Engineer; materials rejected by Geotechnical Engineer shall be removed from the site.

**3.4 FOUNDATION PREPARATION OF NEW LOAD BEARING AREAS**

A. A load bearing area is defined as an area supporting loads of a structure or pavement area subject to motor traffic.

B. After excavating to foundation subgrade elevation, the independent testing agency shall perform soil bearing tests, under the direction of the Geotechnical Engineer, to confirm bearing capacity of the subgrade meets or exceeds the minimum safe bearing capacity noted on the Contract Drawings. If the subgrade does not meet the minimum safe bearing capacity noted on the Contract Drawings, the Engineer will review and provide direction for change in the work. Changes resulting in additional cost or time will be addressed in accordance with the General Conditions, Section 00 72 00.

C. Proofrolling should be performed by a piece of heavy, rubber-tired equipment such as a loaded tri-axle dump truck. The piece of equipment used for proofrolling should weigh at least 70,000 pounds, and should be operated with tire pressures of at least 60 pounds per square inch (psi). The proofrolling equipment should traverse the subgrade at 2 to 3 miles per hour (the pace of a slow walk), making at least one pass in each direction. Proofrolling should be observed by an experienced construction inspector or geotechnical engineer who can evaluate the suitability of the subgrade soils and direct the removal and replacement of any unsuitable soils; all soft spots or irregularities within the natural soil, disclosed as the proof-rolling progresses, shall be excavated to sound material and then backfilled or leveled to grade as hereinafter specified; Engineer shall be so advised by Contractor that additional excavation is necessary to achieve satisfactory proof-rolling; additional excavation required will be paid for by Change Order. Suitable backfill to replace unacceptable soil in load bearing areas shall be select granular material.

D. If rock is exposed at design footing grades, the rock shall be over-cut one foot and replaced with select stone fill. No additional payment will be made for this work.

**3.5 SHORING, SHEETING AND BRACING**

A. Install shoring, sheeting and bracing to comply with Federal, State and local code requirements. Responsibility for the safety of the work, personnel and structures rests solely with the Contractor.

B. Carry the bottom of the support system to depth below the main excavation, adequate to prevent ground movement.

C. Follow the excavation closely with sheeting and shoring placement.

D. Perform excavation for the installation of sheeting carefully to minimize the formation of voids.

E. If unstable material is encountered during excavation, take measures to contain it in place and prevent ground displacement.

F. Have sufficient quantity of material on hand at all times for sheeting, shoring, bracing and other operations for the protection of the work and for use in case of accident or emergency.

G. Leave sheeting and shoring in place as long as possible, compatible with the placing and compacting of backfill.

H. See specification Section 31 50 00 for additional requirements.

**3.6 EXCAVATION – GENERAL**

A. Excavate to the neat lines or setback lines for mixed face conditions and grades indicated on the Contract Drawings.

B. Excavate in sequence and stages which will not subject permanent or temporary structures, installations, or surfaces to unstable conditions.

C. Excavate as required to provide sufficient working space to permit placing, inspection, and completion of the structures.

D. Shape excavations accurately to the cross-sections and grades indicated.

E. Support the sides of excavations as specified or required.

F. Keep excavations free from water.

G. Fill all openings and fractures in the excavation bottom and sides with cement grout to preclude potential development of soil piping and pinholes. Obtain Engineer's written approval of the foundation excavation before placing any foundation stone bedding or construction concrete. This additional work will be paid for by Change Order.

H. The Contractor's failure to maintain dewatering operations for structure excavations shall not be a basis for payment for removal and replacement of unsuitable materials.

**3.7 EXCAVATION WITHIN LOAD BEARING FILL AREAS**

A. After completion of the fill placement and compaction specified under this Specification the independent testing agency will perform test, under the direction of the Geotechnical Engineer, to confirm soil densities in compliance with these specifications and the Contract Drawings; if they do not, compaction and lab tests must be redone. Receive approval of the Engineer, and then footing excavation can begin.

B. Footing Inspections: The Geotechnical Engineer and Independent Testing Agency shall inspect footing excavations for the building foundations; they shall verify, using Method ASTM D1556 or D2922, that specified compaction has been achieved to support the design and that no loose pockets exist beneath the bearing surfaces of the footing excavations.

C. Backfilling:
1. Any excavation (such as for utilities, walls, footings, etc.) done within the load bearing fill area shall be backfilled with load bearing fill material with placement and compaction as described in this Section.
2. Where load bearing backfill is placed against walls, either (1) the difference in elevation of the top of the load bearing fill on either side of the wall shall not be allowed to exceed 1'-0" or (2) the wall shall be adequately braced.

**3.8 BLASTING**

A. No blasting will be permitted.

**3.9 BACKFILLING STRUCTURES**

A. Do not commence backfilling around any structure until such structure has been examined and approved by the Geotechnical Engineer.

B. Do not place backfill until the requirements for concrete curing and waterproofing have been complied with and, if required, test cylinders for the particular structure indicate that the concrete has attained the compressive strength specified.

C. When backfilling against structures and where applicable, place backfill material in equal lifts and to similar elevations on opposite sides of structures in order to equalize opposing horizontal pressures. Place material in uniform increments over fill area.

D. Protect structures from damage by construction activity, equipment, and vehicles. Repair or replace damaged structures to the satisfaction of the Owner.

**3.10 DISPOSAL OF EXCAVATED MATERIAL**

A. Excavated material remaining after completion of backfilling shall be become the property of the Contractor, removed from the construction site, and legally disposed.

**3.11 EMBANKMENT AND FILLS**

A. Do not place fill on any part of the embankment foundation until such areas have been examined and approved.

B. Do not place fill on frozen surface.

C. Place embankment fill in layers of uniform thickness for entire width so that each layer can be uniformly compacted.

D. Avoid accumulation of large pieces of material at one location; fill voids and interstices with fine materials.

E. Compact embankment materials of fills within 5 feet of structures using lightweight compactors; do not overstress the structures.

F. Construct the finished subgrade to vary not more than 1/2" above or 1" below the elevation shown; complete embankment slopes to vary not more than 6" from the slope line shown.

G. Place fill material over the fill areas and spread in loose horizontal layers, not exceeding equipment manufacturer's recommended uncompacted thickness; cobble size rock fragments may be placed in the lower three feet in areas where the fill is greater than eight feet; all rock shall have interstices filled with smaller rock sizes; work fill material in a direction parallel to the long axis of the fill section unless otherwise approved by the Geotechnical Engineer; the gradation and distribution of fill material shall be such that the area will be free from lenses, pockets, and layers of material differing substantially in texture or gradation from surrounding material; after spreading, harrow fill material if necessary to break up large pieces and blend materials.

H. Where compacted fill is to be placed on a slope, bench the slope in horizontal and vertical faces of such width and depth as to provide adequate keying of the fill into the slope; in places where the movement of large equipment is restricted, place fill material in maximum 4" layers and compact with smaller vibratory rollers or power tampers; take particular care to thoroughly compact in areas where fill is placed against exposed bedrock.

**3.12 DENSITY TESTING**:

A. Under the direction of the Geotechnical Engineer, the Contractor's testing agency shall conduct density tests at locations as follows during backfilling operations:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one (1) test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one (1) test for each 100 feet or less of wall length, but no fewer than 2 tests.

B. Determine density by ASTM D1556 or ASTM D2922.

**3.13 MOISTURE CONTROL**

A. Control moisture content of fill materials to ±2% of the optimum moisture content as determined by ASTM D698; material that is too wet may be spread and scarified on the fill surface and permitted to dry, until the moisture content is within specified limits; when fill material is too dry, sprinkle each layer of the fill and work moisture into the material until a uniform distribution within the specified limits is obtained; if, in the opinion of the Geotechnical Engineer, the top surface of a partial fill section becomes too dry to permit a suitable bond, scarify loosen the dried surface, dampen the loosened material and compact the moistened material.

B. Keep the top plane of load bearing fill areas under construction sloped for drainage; when rain or inclement weather is expected, flat roll the top of embankment to seal it.

**3.14 SURFACE DRAINAGE**

A. Intercept and divert surface drainage away from the excavation by the use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water.

C. Remove the surface drainage system when no longer required.

D. Remove debris and restore the site or sites to original condition.

**3.15 DRAINAGE AND DEWATERING OF EXCAVATED AREAS**

A. Provide and maintain ditches to collect surface water and seepage which may enter the excavations and divert.

B. Install a dewatering system to keep excavations dry and free of water.

C. Maintain water level below subgrade until concrete work or backfill, or both, have been completed to offset uplift pressures.

D. Dispose of precipitation and subsurface water clear of the work. Provide necessary sediment and erosion control plan requirements.

E. During dewatering operations, water discharged to a watercourse must be clear and free of silt, mud and other deleterious materials. Construct and maintain settling ponds to prevent stream degradation. Comply with the requirements for dewatering or discharging to a watercourse as required by Federal, State or local codes.

F. Backfill drainage ditches, sumps, and settling basins when no longer required with granular material or other material as approved by the Engineer.

**3.16 FINISHING**

A. On completion of the work, clean ditches and channels and finish the site in a neat and presentable condition. Slope areas to provide positive drainage.

B. Place topsoil and seed all areas disturbed by construction as specified in Section 31 22 19, Finish Grading and Seeding, unless otherwise indicated.

**3.17 PLACEMENT OF PERVIOUS MATERIAL - STONE UNDER SLAB**

A. Install geotextile fabric over subgrade or compacted select granular material fill prior to placement of AASHTO #57; install according to manufacturer's instructions.

B. Grade AASHTO #57 smooth and even, free of voids, compacted, and to required thickness and elevation; provide final grades within a tolerance of 1/2" when tested with a 10-foot straightedge. No equipment shall drive directly on top of the geotextile material.

C. Compaction shall continue until all compaction marks are eliminated and the course is thoroughly and properly compacted.

**END OF SECTION 31 20 00**

# SECTION 31 22 19

# FINISH GRADING AND SEEDING

## PART 1 GENERAL

### 1.1 SUMMARY

A. The work of this Section includes, but is not limited to:
   1. Placing topsoil
   2. Soil conditioning
   3. Finish grading
   4. Seeding
   5. Maintenance
   6. Termite Control

B. The "Seeding Restoration Table" shown on the Contract Drawings lists specified seeding restoration requirements.

C. Related Work Specified Elsewhere
   1. Section 31 11 00 - Clearing and Grubbing
   2. Section 31 20 00 - Earthwork
   3. Section 31 23 16 - Trenching, Backfilling & Compacting

### 1.2 QUALITY ASSURANCE

A. Soil and soil supplement testing shall be performed by a Soils Testing Laboratory engaged and paid for by the Contractor and approved by the Engineer.

B. Collect soil samples under the direction of the Engineer.

C. Reference Standards:
   1. Maryland Department of Transportation - Standard Specifications for Construction and Materials, 1993 as Amended.
   2. Maryland State Board of Agriculture, "Seed Regulations", as Amended.
   3. Requirements of Turf Grass Law and Regulations, Publication No. 41.
   4. Maryland Standard Method of Procedure.

### 1.3 SUBMITTALS

A. Certificates
   1. Prior to use or placement of material, submit a Statement of Compliance from the materials suppliers, together with supporting data, attesting that the composition of the following products meets specification requirements.
      a. Topsoil analysis - State pH, texture, and organic content.
      b. Fertilizer - analysis content and percent of each.
      c. Lime - analysis content and percent of each.
      d. Seed mixture(s) - State percentage of mixtures, purity, germination and maximum weed seed content of each grass mixture.
   2. If soil tests are performed to justify decreased liming and fertilizer rates, submit certified soil sample analyses, including laboratory's recommended soil supplement formulation.

### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Seed
   1. Deliver seed fully tagged and in separate packages according to species or seed mix.
   2. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

**PART 2 PRODUCTS**

**2.1 TOPSOIL**

A. All topsoil stripped from the site and stockpiled may be reused provided the following requirements are met:
   1. Have a pH of between 6.0 and 7.0; contain not less than 2% nor more than 10% organic matter as determined by AASHTO T194.
   2. Fertile friable loam, sand loam, or clay loam which will hold a ball when squeezed with the hand, but which will crumble shortly after being released.
   3. Free of clods, grass, roots, or other debris harmful to plant growth. Free of pests, pest larvae, and matter toxic to plants.
   4. Topsoil shall comply with the requirements of Section 920.01.01 of the Maryland Department of Transportation, State Highway Administration Standard Specifications.

**2.2 SEED**

A. Fresh, clean, dated material from the last available crop and within the date period specified, with a date of test not more than 9 months prior to the date of sowing.

B. Percentage of pure seed present shall represent freedom from inert matter and from other seeds distinguishable by their appearance.

C. All seeds will be subject to analysis and testing.

D. Seed shall be certified by the Maryland State Board of Agriculture and shall conform to requirements of Maryland Turf Grass Law and Regulations, Publication No. 41.

E. Seed mix shall be in accordance with Maryland Department of Transportation Standard Specifications, Sections 705.01.02 and 920.04.02.

F. Seeding shall be accomplished in accordance with Maryland Department of Transportation Standard Specifications, Section 701.01.03.

G. Seed shall comply with Maryland Department of Transportation Standard Specifications, Section 920.04.01.

**TABLE 1 - GRASS AND AGRICULTURAL SEEDS**

| Species | Minimum Guaranteed Purity (Percent) | Maximum Weed Seed (Percent) | Minimum Guaranteed Germination (Percent) |
|---|---|---|---|
| Kentucky Bluegrass (Poa pratensis) Domestic origin<br>min. 21 lb. per bushel | 90 | 0.20 | 80 |
| Perennial Ryegrass (Lolium perenne, var. Pennfine) | 98 | 0.15 | 90 |
| Kentucky 31 Fescue (Festuca elatior arundinacea) | 98 | 0.25 | 85 |
| Crownvetch (coronilla varia, var. Penngift) | 99 | 0.10 | 70 |
| Pennlawn Red Fescue (Festuca rubra, var. Pennlawn) | 98 | 0.15 | 85 |
| Annual Ryegrass (Lolium multiflorum) | 95 | 0.15 | 90 |
| Timothy (Phleum pratense) | 98 | 0.25 | 95 |

**2.3 FERTILIZER**

A. Liquid formulations may be used in lieu of dry formulations, provided the rate of application is adjusted to apply the same quantities of nitrogen, phosphorus and potassium per unit area as specified for dry formulations.

B. Fertilizer in accordance with Section 920.03 of the Standard Specifications for Construction and Materials, Maryland Department of Transportation, 1993, and applied in accordance with Section 705.03.01(e).

C. Contractor may submit soils samples to an approved laboratory for fertilizing recommendations. Recommendations shall be submitted to Owner for his review and decision relating to modifying the application rate as shown on the Restoration Table.

**2.4 LIME**

A. Conform to Section 920.02 of the Standard Specifications for Construction and Materials, Maryland Department of Transportation, 1993, and apply in accordance with Section 705.03.03.

B. All lime in accordance with application rates shown in the Restoration Table.

**2.5 INOCULANT**

A. Inoculate leguminous seed before seeding with nitrogen fixing bacteria culture prepared specifically for the species.

B. Do not use inoculant later than the date indicated by the manufacturer.

C. Protect inoculated seed from prolonged exposure to sunlight prior to sowing.

D. Reinoculate seed not sown within 24 hours following initial inoculation.

**2.6 EROSION CONTROL FABRIC**

A. Shall be a knitted construction of yarn with uniform openings interwoven with strips of biodegradable paper, furnished in rolls with 4-mil opaque polyethylene base as protection for outdoor storage.

B. Fabric 0.2 pound per square yard.

**2.7 JUTE MATTING**

A. Shall be heavy weight, minimum 0-9 pound per square yard, jute mesh with 1" opening.

**2.8 FABRIC/MATTING ANCHORS**

A. Staples for fastening fabric to ground shall be minimum 11 gauge wire, “U” shaped, with a 1" crown and 6" legs.

**2.9 MULCHING MATERIALS**

A. Mulches for seeded areas shall be one, or a combination, of the following:
   1. Timothy hay or mixed clover and timothy hay, or wheat, or oat straw; thoroughly threshed.
      a. Cured to less than 20% moisture content by weight.
      b. Containing no stems of tobacco, soybeans, or other coarse or woody material, free of mature seed bearing stalks or roots of prohibited or noxious weeds.
   2. Wood Cellulose
      a. Containing no growth or germination-inhibiting substances.
      b. Green-dyed and air-dried.
      c. Packages not exceeding 100 pounds.
      d. Moisture Content: 12% + 3%
      e. Organic Matter (Dry oven basis) 98.6% + 0.2%
      f. Ash Content: 1.4% + 0.2%
      g. Minimum Water-Holding Capacity: 100%
   3. Mushroom Manure:
      a. Organic origin, free of foreign material larger than 2" and substances toxic to plant growth.
      b. Organic Matter: 20% minimum
      c. Water-Holding Capacity: 120% minimum
      d. pH: 6.0

B. Mulch Binders
   1. Emulsified Asphalt AASHTO M140, Grade SS-1.

2. Cut Back Asphalt AASHTO M81, RC 250.
3. Nonasphaltic Emulsion - Natural Vegetable Gum Blended with Gelling and Hardening Agents
4. Polyvinyl Acetate Emulsion Resin, Containing 60% (+ 1%) total Solids by Weight.

**2.10 SOIL TREATMENT MATERIALS**

A. Chemicals
   1. Soil treatment chemicals shall be one of the following, or equal:
      a. Dursban TC: To be used at a concentration of 1.0%, applied in water emulsion.
      b. Dragnet TC: To be used at a concentration of 0.5%, applied in water emulsion.
      c. Pryfon 6: To be used at a concentration of 0.75% applied in water emulsion.
   2. Soil treatment chemicals used shall be mixed in the following proportions:
      a. Dursban TC: 1.0% water emulsion, 2 gallons of Dursban TC per 98 gallons of water.
      b. Dragnet TC: 0.5% water emulsion, 1.25 gallons of Dragnet TC per 98.75 gallons of water.
      c. Pryfon 6: 0.75% water emulsion, 1 gallon of Pryfon 6 with 96 gallons of water.

**PART 3 EXECUTION**

**3.1 TIME OF OPERATIONS**

A. Conduct seeding operations during the times specified in the Seeding Restoration Table.

**3.2 PREPARATION OF SUBGRADE**

A. “Hard pan” or heavy shale
   1. Plow to a minimum depth of 6".
   2. Loosen and grade by harrowing, discing, or dragging.
   3. Hand rake subgrade.
   4. Remove stones over 2" in diameter and other debris.

B. Loose loam, sandy loam, or light clay
   1. Loosen and grade by harrowing, discing, or dragging.
   2. hand rake subgrade.
   3. Remove rocks over 2" in diameter and other debris.

**3.3 PLACING TOPSOIL**

A. Place topsoil and spread over the prepared subgrade to obtain the required depth and grade elevation.

B. Final compacted thickness of topsoil not less than thickness shown on Drawings.

C. Roller weight over 120 pounds per foot of width shall not be used for compaction.

D. Hand rake topsoil and remove all materials unsuitable or harmful to plant growth.

E. Do not place topsoil when the subgrade is frozen, excessively wet, or extremely dry; do not handle topsoil when frozen or muddy.

F. Material unsuitable for finish grading which accumulates during spreading and raking shall be removed and legally disposed of off site by Contractor.

G. Finish surface of topsoil shall be smooth, even and true to lines and grades with no ponding areas.

**3.4 TILLAGE**

A. After seed bed areas have been brought to proper compaction elevation, thoroughly loosen to a minimum depth of 5" by discing, harrowing, or other approved methods.

B. Do not work topsoiled areas when frozen or excessively wet.

C. Liming:
   1. Distribute limestone uniformly at the rate indicated on the Seeding Restoration table.
   2. Thoroughly incorporate into the topsoil to a minimum depth of 4" as a part of the tillage operation.

D. Basic Fertilizer
   1. Distribute basic fertilizer uniformly at the rate indicated on the Seeding Restoration Table.
   2. Incorporate into soil to depth of 4" by approved methods as part of tillage operation.

E. Liming and fertilizer rates may be decreased if lesser rates are indicated by soil tests provided by the Contractor.

**3.5 FINISH GRADING**

A. Remove unsuitable material larger than 2" in any dimension.

B. Uniformly grade surface to the required contours without the formation of water pockets.

C. Rework areas which puddle by the addition of topsoil and fertilizer; rerake.

D. Distribute starter fertilizer at the rates indicated on the Seeding Restoration Table.

E. Incorporate starter fertilizer into the upper 1" of soil.

**3.6 SEEDING**

A. Uniformly sow specified seed mix by use of approved hydraulic seeder, power-drawn drill, power-operated seeder or hand-operated seeder, or by hand.

B. Do not seed when winds are over 15 mph.

C. Upon completion of sowing, cover seed to an average depth of 1/4" by hand reraking or approved mechanical methods.

D. Upon completion of seed covering, roll the area with a roller, exerting a maximum force of 65 pounds per foot width of roller.

**3.7 MULCHING**

A. Mulch within 48 hours of seeding.

B. Place hay and straw mulch in a continuous blanket at a minimum rate of 1,200 pounds per 1,000 square yards.

C. Anchor hay or straw mulch by use of twine, stakes, wire staples, paper or plastic nets.

D. Emulsified asphalt or cut back asphalt may be used for anchorage provided it is applied uniformly at a rate not less than 31 gallons per 1,000 square yards.

E. Chemical mulch binders or a light covering of topsoil may be used for anchorage when the size of the area precludes the use of mechanical equipment.

F. Apply approved chemical mulch binders at the manufacturer’s recommended rate.

G. Apply wood cellulose fiber hydraulically at a rate of 320 pounds per 1,000 square yards; incorporate as an integral part of the slurry after seed and soil supplements have been thoroughly mixed.

H. Spread mushroom manure uniformly to a minimum depth of ½" or to the depth indicated on the Contract Drawings.

I. When mulch is applied to grass areas by blowing equipment, the use of cutters in the equipment will be permitted to the extent that a minimum of 95% of the mulch is 6" or more in length.

J. For cut mulches applied by the blowing method, achieve a loose depth in place of not less than 2".

K. Asphalt Mix Method
   1. Apply the mulch by blowing.
   2. Spray the asphalt binder material into the mulch as it leaves the blower.
   3. Apply the binder to the mulch in the proportion of 1.5 to 2.0 gallons per 45 pounds of mulch.
   4. Protect structures, pavements, curbs, and walls to prevent asphalt staining.
   5. Erect warning signs and barricades at intervals of 50 feet or less along the perimeter of the mulched area.
   6. Do not spray asphalt and chemical mulch binders onto any area within 100 feet of a stream or other body of water.

## 3.8 MAINTENANCE

A. Contractor shall be responsible for maintenance of seeded work.

B. Maintenance includes watering, weeding, initial mowing, cleanup, edging, and repair of washouts or gullies.

C. Keep seeded areas wet, close to the saturation point, to a depth of 3" for a period of 10 days following seeding and sodding.

D. Those areas which do not show a prompt catch of grass within 10 days of seeding or sodding shall be reseeded or resodded until complete grass catch occurs.

E. When the grass reaches an average height of 2-1/2", cut to a height of 1-1/2"; irregularities or depressions which show up at this time shall be leveled and reseeded.

F. Contractor's maintenance shall continue until all areas are grassed and free from bare spots or off-color areas, and all work under this Contract is complete and accepted.

## 3.9 SOIL TREATMENT

A. Application
   1. Treat all soil under floor slabs of building and at footings and foundation walls.
   2. Treatment should not be made (1) when the soil or fill is excessively wet or (2) directly following rains, as, in such instances, it will not penetrate to the desired depth, and some of the chemical may be lost through surface runoff.
   3. At Foundation Wall:

      a. Along the outside of the foundation wall, before backfilling, apply the treatment by pouring at bottom of trench.

      b. Backfill approximately 6", tamp and again apply the treatment.

      c. Repeat until backfilling has been brought to proper grade.

      d. All treatment shall be covered with earth.

      e. Application shall be at the rate of 4 gallons per 5 linear feet total for all pours.

4. Rate of Application for Slab-on-Ground Type of Construction

a. Apply 1 gallon per each 10 square feet of soil surface as an overall treatment prior to pouring the slab.

b. Unless the treated soil or fill is to be covered promptly with a vapor barrier or by the slabs, precautions must be taken to prevent disturbance of the treatment by humans or animals.

B. Apply soil treatment at the rate of 2 gallons per 5 lineal feet at the following areas
1. Immediately below expansion joints, control joints and all areas where slab will be penetrated by construction features.
2. When exterior facings or veneers extend below grade level, along the exterior side of all foundation walls, or where unit masonry foundation construction is used.

**END OF SECTION 31 22 19**

# SECTION 31 23 16

# TRENCHING, BACKFILLING AND COMPACTING

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Work Of This Section Includes, But Is Not Limited To
   1. Trench excavation, backfill and compaction
   2. Support of excavation
   3. Pipe bedding requirements
   4. Control of excavated material
   5. Restoration of unpaved surfaces

B. Related Work Specified Elsewhere
   1. Section 31 11 00 - Clearing and Grubbing
   2. Section 31 20 00 - Earthwork
   3. Section 31 22 19 - Finish Grading and Seeding
   4. Section 40 23 19 - Pipe and Pipe Fittings

### 1.2 QUALITY ASSURANCE

A. Testing Agency: Density testing shall be performed by an independent soils testing laboratory engaged and paid for by the Contractor and approved by the Engineer

B. Referenced Standards
   1. American Society For Testing And Materials (ASTM)
      a. D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
      b. D1556 - Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method
      c. D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
      d. Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods

C. Density Testing
   1. Contractor shall schedule and conduct a pre-construction meeting for all parties concerned with Special Inspection to reach agreement on all issues, scheduling, and procedures.
   2. Determine density by ASTM D1556 or ASTM D2922 in areas other than state highways and shoulders.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 33 00.

B. Certificates
   1. Submit, prior to delivery of the material to the job site, a Statement of Compliance from the materials supplier, together with supporting data, attesting that the composition analysis of pipe bedding and select material stone backfill materials meets specification requirements. Should a change in source of materials be made during construction, submit a new Statement of Compliance from the new source for approval before the material is delivered to the job site.
   2. Submit certified density testing results from the soils testing laboratory.

C. Compaction Equipment List: Submit a list of all equipment to be utilized for compacting, including the equipment manufacturer's lift thickness limitations.

D. Agreements with Property Owners: Prior to storing or disposing of excavated materials on private property, submit a copy of the written agreement with the property owner.

E. Contractor to provide to the Engineer for review and approval a grain size distribution curve, result of Atterberg limit testing, and ASTM D1557 Modified Proctor test results prior to delivery of select soil at the project site. Classification testing indicated above shall be provided for each on-site and borrow source proposed to be used as select borrow.

### 1.4 JOB CONDITIONS

A. Classification of Excavation: All excavation work performed under this contract is unclassified, and includes excavation and removal of all soil, shale, rock boulders, fill, and all other materials encountered of whatever nature.

B. Protection of Existing Utilities and Structures:
   1. Take all precautions and utilize all facilities required to protect existing utilities and structures. Advise each Utility at least 3 working days in advance of intent to excavate, do demolition work and give the location of the job site. Request cooperative steps of the Utility and suggestions for procedures to avoid damage to its lines.
   2. Advise each person in physical control of powered equipment used in excavation or demolition work of the type and location of utility lines at the job site, the Utility assistance to except, and procedures to follow to prevent damage.
   3. Immediately report to the Utility and the Engineer any break, leak or other damage to the lines or protective coatings made or discovered during the work and immediately alert the occupants of premises of any emergency created or discovered.
   4. Allow free access to Utility personnel at all times for purposes of maintenance, repair and inspection.

## PART 2 PRODUCTS

### 2.1 PIPE BEDDING MATERIAL

A. Type II and Type IV Bedding Material: Crushed stone or gravel aggregate conforming to AASHTO No. 8.

### 2.2 BACKFILL MATERIAL

A. Select Material Backfill: Crushed stone or gravel aggregate conforming to Fine Aggregate, Section 901, Table 901A of Maryland Department of Transportation State Highway Administration Standard Specifications or a select soil with a maximum dry density of at least 105-pcf in accordance with ASTM D1557, maximum percent passing the No. 200 sieve of 30-percent, maximum liquid limit of 34, and a maximum plasticity index of 7.

B. Suitable Backfill Material

   1. From top of pipe bedding material to 24" over top of pipe
      a. Material excavated from the trench if free of stones larger than 2" in size and free of wet, frozen, or organic materials.

   2. From 24" above pipe to subgrade elevation
      a. Material excavated from the trench if free of stones larger than 8" in size and free of wet, frozen, or organic materials.

C. Unsuitable Backfill Material: where the Engineer deems backfill material to be unsuitable and rejects all or part thereof due to conditions prevailing at the time of construction, remove the unsuitable material and replace with select material stone backfill as specified in paragraph 2.02A or suitable foreign backfill material.

## PART 3 EXECUTION

### 3.1 MAINTENANCE AND PROTECTION OF TRAFFIC

A. Coordinate the work to ensure the latest inconvenience to traffic and maintain traffic in one or more unobstructed lanes unless closing the street is authorized.

B. Maintain access to all streets and private drives.

C. Provide and maintain signs, flashing warning lights, barricades, markers, and other protective devices as required to conform with construction operations and to keep traffic flowing with minimum restrictions.

D. Comply with State and local codes, permits and regulations.

### 3.2 CUTTING PAVED SURFACE

A. Where excavation includes breaking a paved surface, make cuts in a neat uniform fashion forming straight lines parallel with the centerline of the trench. Cut offsets at right angles to the centerline of the trench. Saw cut concrete surfaces; saw cut other hard surfaces or make straight cuts with jackhammer. No paving shall be broken except that which has been previously cut.

B. Protect edges of cut pavement during excavation to prevent raveling or breaking; square edges prior to pavement replacement.

### 3.3 BLASTING

A. No blasting will be permitted.

### 3.4 TRENCH EXCAVATION

A. Topsoil Stripping and Stockpiling: Strip topsoil encountered during trench excavation to its full depth and stockpile for reuse.

B. Depth of Excavation
   1. Gravity Pipelines: Excavate trenches to the depth and grade shown on the profile drawings for the invert of the pipe plus that excavation necessary for placement of pipe bedding material.
   2. Pressure Pipelines:
      a. Excavate trenches to the minimum depth necessary to place required pipe bedding material and to provide 4' from the top of the pipe to the finish ground elevation, except where specific depths are otherwise indicated on the Contract Drawings.

      b. Where unsuitable bearing material is encountered in the trench bottom, continue excavation until the unsuitable material is removed, solid bearing is obtained or can be established, or concrete cradle can be placed. If no concrete cradle is to be installed, refill the trench to required pipeline grade with pipe bedding material.

      c. Where the Contractor, by error or intent, excavated beyond the minimum required depth, backfill the trench to the required pipeline grade with pipe bedding material.

C. Width of Excavation

1. Excavate trenches to a width necessary for placing and jointing the pipe and for placing and compacting bedding and backfill around the pipe.
2. Shape trench walls completely vertical from trench bottom to at least 24" above the top of pipe.
3. For pressure pipeline fittings, excavate trenches to a width that will permit placement of concrete thrust blocks. Provide earth surfaces for thrust blocks that are perpendicular to the direction of thrust and are free of loose or soft material.
4. Where rock is encountered in the sides of the trench, remove the rock to provide a minimum clearance between the pipe and rock of 6".

D. Length of Open Trench: Do not advance trenching operations more than 50' ahead of completed pipeline.

E. Pipes Install in Fills:
1. Except where multiple pipes are installed in one trench no pipe or utility may be laid except in a prepared trench excavation having a top elevation at least one foot above the top of the highest pipe or utility in the trench. Where pipes or utilities are to be placed entirely or partly in fills, the fill must be properly compacted and brought up to the required elevation before the trench excavation is performed.

## 3.5 SUPPORT OF EXCAVATION

A. Support excavations with sheeting, shoring, and bracing or a “trench box” as required to comply with Federal and State laws and codes. Install adequate excavation supports to prevent ground movement or settlement to adjacent structures, pipelines or utilities. Damage due to settlement because of failure to provide support or through negligence or fault of the Contractor in any other manner shall be repaired at the Contractor’s expense.

B. Withdraw shoring, bracing, and sheeting as backfilling proceeds unless otherwise directed by the Engineer.

## 3.6 CONTROL OF EXCAVATED MATERIAL

A. Keep the ground surface within a minimum of 2' of both sides of the excavation free of excavated material.

B. In areas where pipelines parallel or cross streams, ensure that no material slides, is washed, or dumped into the stream course. Remove cofferdams immediately upon completion of pipeline construction.

C. Maintain accessibility to all fire hydrants, valve pit covers, valve boxes, curb boxes and other utility controls at all times. Keep gutters clear or provide other satisfactory facilities for street drainage. Do not obstruct natural watercourses. Where necessary, provide temporary channels to allow the flow of water either along or across the site of the work.

D. Provide temporary barricades to prevent excavated material from encroaching on private property, walks, gutters, and storm drains.

## 3.7 DEWATERING

A. Keep excavations dry and free of water. Dispose of precipitation and subsurface water clear of the work.

B. Maintain pipe trenches dry until pipe has been jointed, inspected, and backfilled, and concrete work has been completed. Prevent trench water from entering pipelines under construction.

C. Intercept and divert surface drainage away from excavations. Maintain storm drainage facilities, gutters, and natural surface watercourses open and in operation. Provide and install temporary

facilities to maintain excavations free of water as required. Design surface drainage systems so that they do not cause erosion on or off the site, or cause unwanted flow of water. When mechanical equipment is utilized to control water conditions, provide and maintain sufficient standby units onsite.

D. Comply with Federal and State requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control. Comply with the Sediment and Erosion Control Plan.

## 3.8 PIPE BEDDING REQUIREMENTS

A. Type II Bedding
   1. Depth of bedding material aggregate as shown on Standard Detail.
   2. Provide Type II bedding as minimum for all pipe materials except plastic pipe, unless otherwise authorized by the Engineer.

B. Type IV Bedding
   1. Depth of bedding material aggregate as shown on Standard Detail.
   2. Provide Type IV bedding when using ABS, PE, and PVC pipe.

C. Shape recesses for the joints or bell of the pipe by hand. Assure that the pipe is supported on the lower quadrant for the entire length of the barrel.

## 3.9 PIPE LAYING

A. Lay pipe as specified in the appropriate Section of these Specifications for pipeline construction.

## 3.10 THRUST RESTRAINT

A. Provide pressure pipe with concrete thrust blocking or use restrained joint fittings at all bends, tees, valves, and changes in direction, in accordance with the Specifications, Contract Drawings, and Standard Details.

## 3.11 BACKFILLING TRENCHES

A. After pipe installation and inspection, backfill trenches from trench bottom or from the top of pipe bedding material, whichever is greater, to 12" above the crown of the pipe with specified backfill material hand placed and carefully compacted with hand-operated mechanical tampers in layers of suitable thickness to provide specified density around and under the haunches of the pipe. Backfill and compact the remainder of the trench with specified backfill material.

B. Exposed Joints for Testing
   1. The Contractor has the option to test the pipe prior to backfilling the trench. If this option is selected, install reaction blocks where required and place 2' of thoroughly compacted backfill over the pipe leaving pipe joints partially exposed.
   2. If the Contractor elects to completely backfill the trench prior to testing, the Contractor shall be responsible for locating and uncovering leaks which may cause the test to fail.

C. Lift thickness Limitations
   1. In no case shall maximum lift thickness placed exceed the maximum limits specified by the manufacturer’s recommendations. However, if the equipment manufacturer’s lift thickness recommendation is followed and the specified density is not obtained, the Contractor shall, at his own expense, remove, replace, and retest as many times as is required to obtain the specified density.
   2. Compact each layer of material to 95% of the maximum density at + two percent (+2%) of the optimum moisture content as determined by ASTM D698.

3. Notwithstanding the specified requirements for trench backfill compaction, trenches that settle below the surrounding grade prior to final completion shall be filled to surrounding grade level with appropriate materials.

**3.12 UTILITY MARKING TAPE**

A. Install detectable utility marking tape as specified in Section 40 23 19 above all plastic pressure pipelines, 12"-18" below final grade.

**3.13 DISPOSAL OF EXCAVATED MATERIAL**

A. Excavated material remaining after completion of backfilling shall remain the property of the Contractor, removed from the construction area and legally disposed.

**3.14 RESTORATION OF UNPAVED AREAS**

A. Restore unpaved surfaces disturbed by construction to equal the final grade shown on the Contract Drawings.
B. Restore grassed areas in accordance with Section 31 22 19, Finish Grading and Seeding.

**3.15 COMPACTION FOR SELECT BACKFILL MATERIAL**

A. Select backfill material shall be compacted to 95-percent of the Modified Proctor (ASTM D1557) using loose lifts not to exceed 8-inches in thickness.

**END OF SECTION 31 23 16**

# SECTION 31 23 19

# DEWATERING

## PART 1 GENERAL

### 1.1 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools and equipment necessary to provide construction dewatering to keep all excavations and structures free from water during excavation and construction.

### 1.2 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control surface water and groundwater flows into excavations and permit construction to proceed on dry, stable subgrades.
   1. Dewatering plans, including detailed shop drawings, shall be prepared, sealed and signed by a qualified Professional Engineer registered in the State of Maryland.
   2. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
   3. Prevent groundwater and surface water from entering excavations.
   4. Accomplish dewatering without damaging existing buildings, pavements, utilities, and other improvements adjacent to excavations.
   5. Remove dewatering system when no longer needed.

### 1.3 SUBMITTALS

A. Shop Drawings for Information Only: Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water. Shop drawings shall be prepared, sealed and signed by a qualified Professional Engineer for dewatering systems.
   1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
   2. Include a written report outlining control procedures to be adopted if dewatering problems arise.

B. Qualification Data: For the Professional Engineer and the dewatering system installer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining improvements that might be misconstrued as damage caused by dewatering operations.

D. Record drawings identifying and locating any capped utilities and other subsurface conditions performed during dewatering, including locations and capping depth of wells and well points.

E. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that the dewatering system is capable of meeting performance requirements.

### 1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving the existing pumping station or other facilities unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project Site Information: Geotechnical soil borings have been obtained in the project site area and are available for information only. The soil borings, and opinions expressed in any accompanying reports, are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests and results of analyses conducted by the geotechnical engineer for design purposes only. The County and Engineer will not be responsible for interpretations or conclusions drawn from this data. The Contractor shall make his own test borings and conduct other exploratory operations as necessary for providing dewatering systems.

C. Survey adjacent structures and improvements, employing a qualified Professional Engineer or Land Surveyor, and establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent improvements.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.1 PREPARATION**

A. Protect structures, utilities, pavements, and other facilities and improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during dewatering operations.
   1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
   2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering systems to ensure minimum interference with roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities. Do not close or obstruct roads, streets, alleys, walks, driveways and other adjacent occupied or used facilities without permission of the County and authorities having jurisdiction.

C. Promptly repair damages to adjacent facilities or improvements caused by dewatering operations at no additional cost to the County.

**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.

B. Before excavating below groundwater level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers and structures have been constructed and fill materials placed, or until dewatering is no longer required.

C. Provide an adequate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers and other excavations. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations. Maintain piezometric water level a minimum of 24-inches below surface of excavation.

E. 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 in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to the County.

G. Remove dewatering system upon completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36-inches below overlying construction.

**3.3 OBSERVATION WELLS**

A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers necessary and additional observation wells as may be required by authorities having jurisdiction.

B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation well risers to demonstrate that observation wells are functioning properly.

D. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

**END OF SECTION 31 23 19**

**SECTION 31 25 13**

# EROSION AND SEDIMENTATION CONTROL

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section pertains to the provisions for the control of erosion in the construction area and in stockpile areas including seeding, the construction of temporary swales and sedimentation basins as required and shown on the drawings. All areas where existing vegetation and grass cover have been barred by construction activities shall be protected from erosion.

B. Contractor is responsible for meeting all local, state and federal regulations regarding erosion control including the applicable provisions of the National Pollution Discharge Elimination System, Phase II, regulations from the Clean Water Act.

C. This project shall be designed to meet SHA design criteria. Construction activity pollution prevention is a mandatory requirement.

### 1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Drawings and general provisions of the Contract, including A-Procurement and Contracting Requirements, Division 00 and Division 01 apply to this section.

B. Section 31 11 00 Clearing and Grubbing

C. Section 31 20 00 Earthwork

D. Section 31 23 16 Trenching, Backfilling and Compaction

E. Maryland SHA Standard Specifications for Construction and Maintenance of Highways.

### 1.3 DEFINITIONS

A. Best Management Practices (BMP's) means physical facilities schedules of activities, prohibition of practices, maintenance procedures, and other management practices , when properly designed, installed, and maintained, will be effective to prevent or reduce the discharge of pollution associated with construction activities. BMP's also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

### 1.4 QUALITY ASSURANCE

A. Codes and Standards: Install and maintain erosion control systems in compliance with all authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Contractor shall strive to utilize sustainable materials, which include rapidly renewable materials, regional materials, regionally manufactured materials, regionally extracted materials, recycled contents.

B. Seed, mulch, fertilizer, soil conditioner, soil stabilization matting and other materials for seeding and soil stabilization shall conform to MDSHA 920.

C. Geotextile materials shall conform to MDSHA 921.09

D. No. 57 Stone shall conform to AASHTO M43, No. 57

E. 2 to 3 in. Stone shall conform to AASHTO M43, No. 2

F. ¾ to 1-1/2 in. Stone shall conform to AASHTO M43, No. 4

G. 4 to 7 in. Stone shall conform to MDSHA 901.05

H. Riprap shall conform to MDSHA 901.03

I. Water
   1. Use water for maintaining the grass developed after erosion control seeding and/or sodding. Water shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
   2. Water sources other than the local municipal domestic water supply must be approved by the Owner.
   3. If onsite reclaimed water sources are used, tanks and apprentices must be clearly marked with the words “non-potable” water.

## PART 3 EXECUTION

### 3.1 GENERAL

A. Prior to beginning any earth disturbing activity, complete the following:
   1. Demarcate all wetlands, wetland buffers, floodplains, waters of the United States, tree protection areas, and the Limit of Disturbance (LOD).
   2. Have all demarcated wetlands, wetland buffers, floodplains, water of the United States, tree protection areas, and LOD inspected and approved by the Engineer.
   3. Construct all erosion and sediment control measures.
   4. Have all control measures inspected and approved by the Engineer. Ensure that all runoff is directed from disturbed areas to the sediment control measures. Do not remove any erosion or sediment control measure without the approval of the Engineer and MDE.

### 3.2 CONSTRUCTION SEQUENCE

A. Initial Controls. Install all perimeter controls such as silt fence, earth dikes/swales, check dams, traps, and basins, prior to the grubbing operation. Typically, no controls are required during the clearing operation. If the Engineer determines that the clearing area has been disturbed and a potential for sediment runoff or erosion exists, install the controls at that time as directed.

B. Stabilization Requirements. Permanently or temporarily stabilize areas flatter than 3:1 and stockpile areas as soon as possible, but not later than fourteen days after grubbing and grading activities have ceased in the area. Permanently or temporarily stabilize trap embankments and slopes, earth dikes, temporary swales, perimeter dike/swales, ditches, and slopes 3:1 or steeper as soon as possible, but not later than seven days after grubbing and grading activities have ceased in the area. The seven and fourteen day requirements mean that the stabilization operation is complete within the applicable seven or fourteen day time frame.

When the excavation or embankment reaches the bottom of the subgrade, those areas in which paving will be placed are exempt from the stabilization requirements. Areas between temporary berms, except median areas, need not be stabilized during incremental stabilization. When permanently stabilized areas are disturbed by grading operations or other activities not specifically approved, restabilization will be at no additional cost to the County.

Stabilization requirements may be reduced to less than seven days for sensitive areas. Perform maintenance as necessary to ensure continued stabilization.

Track all slopes within five days of establishment with cleated type equipment operating perpendicular to the slope.

C. Dewatering. Dewatering is considered an elective practice. Ensure that dewatering activities do not cause any visible change to stream clarity. If a sediment plume is visible, immediately cease the dewatering activity.

D. Maintenance. Maintain all erosion and sediment control devices during the construction season, the winter months, and other times when the project is inactive. Maintain access to all erosion and sediment controls until the controls are removed. Lack of this maintenance will be considered as noncompliance with the E & S Plan and grounds for a shutdown of the project.

Inspect controls immediately following storm events. Clean out as necessary and repair all damage as the first order of business after the storm event. Immediately restore all measures to installed condition.

Direct any pumping activity, including dewatering sediment traps and basins, through a dewatering device approved by MDE.

E. Waste Areas. Off-site waste areas on State or Federal property require MDE approval. All other off-site waste areas shall be approved by the appropriate Soil Conservation District for each county or the Baltimore City Department of Public Works. All waste areas and stockpile areas shall be protected by erosion and sediment control measures and stabilized within the seven or fourteen day stabilization requirement.

F. Side or Berm Ditches and Culverts. As a first order of work, construct the side ditches in fill areas and berm ditches in cuts, including lining. Protect these linings from sediment deposits. Place silt fence along the banks of existing streams as shown in the Contract Documents prior to placing any culverts. To avoid sedimentation during construction, divert the streams around the location of the culvert until the proposed culvert and channel are stabilized.

G. Removal of Controls. Do not remove erosion and sediment control measures until all previously disturbed areas are vegetated with at least a 3 in. growth of grass, and the removal has been approved by the Engineer and MDE. Backfill, grade, and stabilized the sediment controls.

Remove all control devices except as directed.

H. Erosion and Sediment Control Original Excavation. Excavate, construct embankments, grade, and backfill for sediment traps, sediment basins, and other sediment controls.

Ensure that excavation and embankments meet the dimensions for each sediment control as specified. Stockpile excavated material and use for backfill when the sediment controls are removed.

I. Erosion and Sediment Control Cleanout Excavation. Remove accumulated sediment from sediment controls or other areas during routine maintenance of sediment controls, or as directed.

Clean out sediment traps as necessary to ensure that at least 50 percent of the wet storage capacity is available at all times. Ensure that riprap outlet sediment traps have at least 75 percent of the wet storage capacity available at all times. Remove sediment from silt fence, super silt fence, stone outlet structures, stone check dams, and straw bales when it reaches 50 percent of the height of the device.

Place removed sediment in an approved waste site either on or off the project. Material stored on-site may be reused once it is dried and it meets embankment requirements.

J. Inlet Protection. Install standard inlet protection, at grade inlet protection, curb inlet protection, or median inlet protection.

K. Silt Fence. Trench the geotextile at least 8 in. vertically into the ground and extend to at least 22 in. above ground. Drive fence posts at least 16 in. into the ground and extend at least 26 in. above the ground.

L. Silt Fence on Pavement. Install as shown on construction plans.

M. Diversion Fence. Trench double 6 mil polyethylene sheeting at least 6 in. into the ground, cover at least 4 ft. from the trench line to the fence posts, extend at least 20 in. above the ground, and wrap over the fence posts to grade.

N. Stabilized Construction Entrance. Construct stabilized construction entrances at the specified locations. Rehabilitate stabilized construction entrance consists of periodic top dressing with additional aggregate, replacement of pipe, or other repairs to the entrance and sediment trapping devices.

O. Stone for Sediment Control. Place No. 57 stone, 3/4 to 1-1/2 in. stone, 2 to 3 in. stone, 4 to 7 in. stone, and riprap for sediment control as specified.

P. Filter Bag. Furnish the required bags, straw bales, stone, pump, hoses, and connections to perform dewatering activities. Determine the dimensions necessary to provide the required storage volume.

Q. Fill and Cut Slopes. Fill slopes in all cases shall be no steeper than 3:1 unless specifically stated on the plans or approved by the Owner's Geotechnical engineer.

When cut slopes exceed 2:1 for depths over three (3) feet, proper bracing and shoring per OSHA requirements shall be used and maintained.

For permanent slopes, cut or fill, between 2:1 and 10:1, erosion protection shall be provided with hydromulching seeding, sodding, or other method as approved.

Where cut slopes of more than 5 feet deep, extend more than 100 feet in length, contractor shall provide a backfill drain at the top of the slope to ease in drainage and erosion control.

## 3.3 INSPECTIONS

A. Inspect all erosion control systems and devices at least once every seven calendar days.

B. Inspect all erosion control systems and devices within 24 hours of the end of any storm which results in precipitation of 1/2 inch or more.

C. During inspections, locations where stormwater leaves the site shall be inspected for evidence of erosion or sediment deposition.

D. Correct deficiencies within three calendar days.

E. Complete a report of each inspection. Report shall contain the following minimum information:
   1. Inspector's name

2. Inspection date
3. Observations of the effectiveness of erosion control systems
4. Actions taken if necessary to correct deficiencies
5. Listing of areas where construction operations have permanently or temporarily stopped
6. Authorized signature

**END OF SECTION 31 25 13**

# SECTION 31 50 00

# EXCAVATION SUPPORT AND PROTECTION

## PART 1 GENERAL

### 1.1 SUMMARY

A. The work to be performed under this section includes, but is not limited to, the furnishing of all materials, labor, tools and equipment necessary to provide temporary structure and excavation support and protection systems.

### 1.2 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection systems capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
   1. Excavation support and protection plans, including detailed shop drawings, design calculations, and a comprehensive engineering analysis, shall be designed, sealed and signed by a qualified Professional Engineer registered in the State of Maryland.
   2. Prevent groundwater and surface water from entering excavations.
   3. Install excavation support and protection systems without damaging existing buildings, pavements, utilities, and other improvements within or adjacent to excavations.

B. Contractor to conduct, as needed, additional subsurface explorations and associated laboratory testing to verify conditions and assumptions used for the design of the excavation support and protection.

### 1.3 SUBMITTALS

A. Shop Drawings, design calculations, and engineering analysis for Information Only: Prepared, sealed and signed by a qualified Professional Engineer for excavation support and protection systems.

B. Qualification Data: For the Professional Engineer and the excavation support and protection system installer.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

D. All test borings and soil data obtained by the Contractor.

### 1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving the existing wastewater treatment plant or other facilities unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

B. Project Site Information: Geotechnical soil borings obtained in the project site area during design, if any, are available for information purposes only. The soil borings, and opinions expressed in any accompanying reports, are those of the geotechnical engineer and represent interpretations of subsurface conditions, tests and results of analyses conducted by the geotechnical engineer for design purposes only. The Owner and Engineer will not be responsible for interpretations or conclusions drawn

from this data. The Contractor shall make his own test borings and conduct other exploratory operations as necessary for providing excavation support and protection.

C. Survey adjacent improvements, employing a qualified Professional Engineer or Land Surveyor, and establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify the Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent improvements.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36, A690, or A992.

C. Steel Sheet Piling: ASTM A328, A572, or A690; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches.

E. Cast-In-Place Concrete: ACI 301, of compressive strength required for the application, in accordance with the design.

F. Reinforcing Bars: ASTM A615, Grade 60, deformed.

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Shore, support and protect structures, utilities, pavements, and other facilities and improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities. Do not close roads, streets, alleys, walks, driveways, residences and other adjacent occupied or used facilities without permission of the Owner and authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction, so that forming and finishing of concrete surfaces, or setting of precast concrete structures, is not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities or improvements caused by installing excavation support and protection systems at no additional cost to the Owner.

### 3.2 SOLDIER BEAMS AND LAGGING

A. Install steel soldier beams before starting excavation. Space soldier beams 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 beams as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at centers as designed and secure to soldier beams.

**3.3 SHEET PILING**

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. 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. Cut tops of sheet piling to uniform elevation at top of excavation.

**3.4 BRACING**

A. Locate bracing to clear permanent construction work. If necessary to move brace, install new brace before moving original brace. Install internal bracing, if required, to prevent spreading or distortion of braced frames. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

**3.5 METHODS**

A. The Contractor may, at his option, furnish and install other supporting systems for the excavation of the pumping station provided the design of such systems is approved by the Owner and the design performed is signed and sealed by a Professional Engineer registered in the State of Maryland. The Contractor shall be responsible for the maintenance of the excavation support system for the full term of the contract. All costs shall be included in the lump sum bid and no separate payment will be made.

**3.6 REMOVAL AND REPAIRS**

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities and utilities.

B. Promptly repair or replace, as approved by the Engineer, adjacent work or improvements damaged or displaced by removing excavation support and protection systems at no additional cost to the Owner.

**END OF SECTION 31 50 00**

# SECTION 32 92 00

# PLANTS AND BULBS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This work shall consist of furnishing and planting annuals, perennials, fall planted bulbs, ornamental grasses and all plant establishment operations to complete the Work as specified in the Contract Documents or as directed by the Engineer.

### 1.2 PLANTING SCHEDULE

| PLANTS | PLANTING DATES |
|---|---|
| Container Grown Summer Annuals | May 10-June 1 |
| Container Grown Winter Annuals | September 15-October 15 |
| Container Field Grown Perennials and Ornamental Grasses | April 15-June 30 or<br>September 1-October 30 |
| Fall Planted Bulbs | October 1-November 30 |

A. Submit a written Modifications Request to perform installation out of season, or to install plants of a different species, cultivars, sizes, growth habits, or planting stock type. Approval must be granted prior to substitution.

### 1.3 SUBMITTALS

A. A breakdown list of contract prices for each plant in the Contract including cost of all installation and establishment operations, per plant shall be submitted

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Plants shall be those shown on the Contract Documents or as directed by the Engineer. No substitutions are permitted unless agreed upon by the Engineer and a County representative following a formal Modifications Request.

## PART 3 EXECUTION

### 3.1 STORAGE AND HANDLING

A. The Contractor shall provide adequate facilities for the protection, watering and temporary storage of all plant material.

### 3.2 PREPARATION FOR PLANTING

A. Layout. The Contractor shall lay out the location of all beds in the field prior to performing any planting operations as approved by the Engineer.

B. Planting Bed Preparation. Two (2) weeks prior to planting, all weeds and grass located within planting bed areas shall be eradicated using glyphosate with a wetting agent in conformance with the Maryland Pesticide Applicator's Law and the manufacturer's recommendations. After the weeds have died, all weeds and debris shall be removed prior to tilling as directed by the Engineer.

**3.3 PLANTING**

A. Plants shall not be installed until inspected by County Representative

B. Annuals and Perennials: Prior to planting, plants shall be removed from pots without damaging plants. Annuals and perennials shall be planted through premulched cultivated beds with the mulch carefully pulled back and replaced to avoid mixing soil and mulch. When planted, the top of the root mass shall be at ground level and the plant shall be in a vertical position.

C. Initial Watering: Plants shall be watered immediately after planting and as required until the plants roots have knitted into the planting bed soil. The watering shall provide full and thorough saturation of the soil in the planting bed. A sprinkler or breaker nozzle shall be used to prevent damage to the plants and disturbance of mulch during water operations.

D. Fertilizing: After the initial watering, a water-soluble 20-20-20 fertilizer shall be applied to each plant as specified in the manufacturer's recommendations.

E. Mulching: Annuals and Perennials – Prior to planting, a one and one-half inch (1-1/2") layer of shredded hardwood bark mulch shall be spread over the prepared planting bed. After planting, an additional one and one-half (1-1/2") shall be evenly spread over the bed.

**3.4 PLANT ESTABLISHMENT**

A. After the initial watering has been completed, plants shall be watered as required at the rate of sixty (60) gal/one hundred (100) ft2 of planting bed. This amount of watering is equivalent to one inch (1") of rainfall.

B. Promptly remove and replace plants that have become unacceptable during the Establishment Phase as needed, or at the request of the ENGINEER.

C. Remove the foliage of annuals that have declined in late summer or fall, as directed by the ENGINEER. Remove the foliage and flower stems of bulbs planted in beds after they have declined at the end of their growing season in June.

**END OF SECTION 32 92 00**

# SECTION 33 01 32

# SANITARY SEWER MANHOLE TESTING

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The work of this section includes, but is not limited to:
   1. Vacuum Testing Sewer Manholes
   2. Exfiltration Testing Sewer Manholes
B. Related work specified elsewhere: Section 33 39 13 – Manholes.

### 1.2 QUALITY ASSURANCE

A. Test Acceptance
   1. No test will be accepted until the results are below the specified maximum limits.
   2. The Contractor shall determine and correct the causes of test failure and retest until successful test results are achieved.

### 1.3 SUBMITTALS

A. Submit the following 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 gauge calibration

### 1.4 JOB CONDITIONS

Do not allow personnel in manholes during vacuum or pressure testing.

## PART 2 PRODUCTS

### 2.1 VACUUM TESTING EQUIPMENT

A. Vacuum pump
B. Vacuum line
C. Vacuum tester base with compression band seal and outlet port
D. Shut-off valve
E. Stop watch
F. Plugs
G. Vacuum gauge, calibrated to 0.1" Hg

### 2.2 EXFILTRATION TEST EQUIPMENT

A. Plugs
B. Pump
C. Measuring device

## PART 3 EXECUTION

### 3.1 TESTING MANHOLES

A. General: Testing using either air or water shall be done whenever possible prior to backfilling to assist in locating leaks. Joint repairs by parging are to be done on both outside and inside of the joint to ensure a permanent seal.

B. Vacuum Test: Vacuum testing of a finished manhole shall be performed with an approved vacuum testing apparatus such as supplied by NPC Systems, Inc. of Milford, NH, and operated according to the recommendations of Peter Glazier and Associates of Worchester, Massachusetts. Apparatus supplied by other manufacturers may also be acceptable, but must have the approval of the Engineer before the test is begun.

1. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.
2. Inflate the compression band to affect a seal between the vacuum base and the structure; connect the vacuum pump to the outlet port with the valve open; draw a vacuum to 10" of Hg; close the valve; start the test.
3. Test: Vacuum testing of a furnished manhole shall be performed with an approved vacuum testing apparatus, but must have the approval of the Engineer before the test is begun.

    a. Determine the test duration for the manhole from the following table:

| VACUUM TEST TABLE | |
|---|---|
| **Manhole Diameter** | **Test Period** |
| 30” | 45 sec. |
| 48" | 60 sec. |
| 60" | 75 sec. |
| 72" | 90 sec. |

    b. Record the vacuum drop during the test period; if the vacuum drop is greater than 1.0" of Hg during the test period, the manhole shall be repaired and retested; if a vacuum drop of 1" of Hg does not occur during the test period, the test shall be discontinued and the manhole will be accepted.

    c. If a unit fails to meet a 1" Hg drop in the specified time after repair, the unit shall be subjected to the water exfiltration test and repaired as necessary.

C. Exfiltration Test

1. Plug all pipes in the manhole; remove any water that has accumulated in the manhole; observe plugs over a period of not less than 2 hours to ensure that there is no leakage into the manhole.
2. Fill the manhole with water to within 4" of the top of the cover frame. Prior to test, allow the manhole to soak from a minimum of 4 hours to a maximum of 72 hours; after the soak period, adjust the water level inside the manhole to within 4" of the top of the cover frame.
3. Measure the water level from the top of the manhole frame; at the end of the 4-hour test period, again measure the water level from the top of the manhole frame; compute the drop in the water level during the test period.
4. The exfiltration test of a manhole shall be considered satisfactory if the drop in water level is less than the values listed in the table below:

| Manhole Depth (Feet) | Allowable Drop in Water Level (Feet) in 30" Diameter Section | |
|---|---|---|
| | 4' Dia. MH | 5' Dia. MH |
| 4 | 0.11 | 0.14 |
| 6 | 0.17 | 0.21 |
| 8 | 0.23 | 0.28 |
| 10 | 0.28 | 0.35 |
| 12 | 0.34 | 0.43 |
| 14 | 0.40 | 0.50 |
| 16 | 0.45 | 0.57 |
| 18 | 0.51 | 0.64 |
| 20 | 0.57 | 0.71 |
| 22 | 0.62 | 0.78 |
| 24 | 0.68 | 0.85 |
| 26 | 0.74 | 0.92 |
| 28 | 0.79 | 0.99 |
| 30 | 0.85 | 1.06 |

5. Based on an allowable exfiltration of 4 gallons per day per foot of depth of a 4-foot diameter manhole with a conical top and a 30” diameter opening; for purposes of the tests, the manhole depth shall be the depth from invert to the bottom of the cover frame, or the depth from the ground water surface to the bottom of the cover frame, whichever is less.
6. In case of unsatisfactory test results, the Contractor shall repair the manhole and retest as often as necessary until satisfactory results are achieved; repair visible leaks regardless of the amount of leakage.

**END OF SECTION 33 01 32**

# SECTION 33 31 00.13

# EXTERIOR PIPING

## PART 1 GENERAL

### 1.1 SUMMARY

**A.** The Contractor shall furnish and install all materials, equipment and appurtenances necessary for the complete and satisfactory installation of all exterior process piping systems as shown on the drawings and as required for a complete installation as specified herein.

B. Related Work Included Elsewhere
   1. Piping for plumbing and HVAC systems shall be as specified in Division 22 and 23 respectively.

### 1.2 QUALITY ASSURANCE

A. Install piping to meet the requirements of state and local building codes.

B. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.

### 1.3 SUBMITTALS

A. Shop Drawings and Product Data
   1. Submit detailed certified dimensional shop drawings and manufacturer's product data for materials and equipment as specified under Section 01 33 00. Show complete information concerning materials of construction, fabrication, protective coatings, installation and anchoring requirements, fasteners and other details.

## PART 2 PRODUCTS

### 2.1 PIPE AND FITTINGS SCHEDULE

A. Pipe and fittings shall be as indicated on the drawings and as listed in the schedule included at the end of this section, the schedule is intended to serve as a general guide and is not necessarily a complete listing of every piping system. Systems which may not be listed shall be comprised of the same kind of pipe and fittings as in similar systems which are listed, or as directed by the Engineer. Interior process piping shall be as specified in Division 44.

### 2.2 GENERAL NOTES – PIPING

A. All pipe and fittings shall be new, of the sizes indicated on the Drawings or specified, and shall be as specified in the schedule herein. Where the pipe schedule permits more than one type of pipe material to be used, details of the pipe at structures or vaults are shown on the Drawings for only one of the pipe materials specified. If the Contractor elects to use the pipe material that is not detailed, it shall be his responsibility to design, and submit shop drawings for approval, indicating all pipe details at structures and vaults. The Contractor shall not be entitled to any extra compensation for such design, shop drawings and their approval, or revisions to the arrangements and details shown on the drawings necessary to accommodate the use of pipe materials not detailed. All such designs prepared by the Contractor shall be as required and approved by the Engineer. Fittings provided for connection to existing piping shall be approved by the Engineer for use with the existing piping and with the new piping.

B. Piping systems that are encountered which are not listed on the schedule herein shall be constructed of the same type of pipe specified for similar systems which are listed, as directed by the Engineer.

C. It shall be the Contractor's responsibility to verify dimensions of all pipes, valves, special castings and fittings so that all of the pipe work performed will fit together properly and will conform to the arrangements shown on the Drawings.

D. The Contractor shall furnish and install all necessary fittings and special pieces required for closures, bends, branches, and connections to other pipes. All fittings and specials shall be designed and constructed to meet the same pressure classification as that of the adjoining pipe, and shall conform to the standard details of the manufacturer.

E. Hubs and spigots shall be at right angles to the axis of the opening and openings shall be at the exact angle shown.

**2.3 GENERAL NOTES – FITTINGS**

A. All fittings shall be of the type indicated on the drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings; stainless steel piping shall be provided with stainless steel fittings. In general, all fittings shall be as specified hereinafter in paragraph entitled "Pipe and Fittings Schedule".

B. Nipples shall be extra heavy of same material as piping system in which they are installed. Close nipples are not acceptable.

C. Wherever the sizes of pipes are reduced, the fittings shall be made to suit these changes without the use of bushings.

**2.4 DUCTILE IRON PIPE AND FITTINGS – CEMENT LINED**

A. Ductile iron pipe shall be Class 52, cement mortar lined, mechanical or push-on joint, one mil thickness bituminous coating on the exterior in accordance with AWWA C151, C110 and C153, as applicable. Cement mortar lining shall be double thickness for all services except potable water. In potable water service, the cement mortar lining shall be standard thickness in accordance with C110.

B. All ductile iron fittings and specials shall be manufactured in accordance with ANSI A21.10 (AWWA C-110) for Gray-Iron and Ductile Iron Fittings, 2" through 48", for Water and Other Liquids. Sizes 3" through 12" shall be pressure rated for 350 psi water pressure plus water hammer; sizes 14" in diameter and larger shall be pressure rated for 250 psi water pressure plus water hammer.

C. Fittings shall be double cement-mortar lined with mechanical joints in accordance with ANSI A-21.10 and ANSI A-21.11. Pressure rating for fittings twelve inches and smaller shall be 250 psi and for fittings larger than twelve inches it shall be 150 psi.

D. Unless otherwise shown on the Drawings or Pipe and Fittings schedule, all fittings, including valves and caps, shall be harnessed to the adjacent pipe with mechanical joint retainer glands for pipe up to 24" in diameter and with American Ductile Iron Lok-Fast Joint, Fast Grip or equivalent product for pipe over 24" in diameter. Glands shall be of ductile iron; and set screws shall be of steel. Retainer glands and Lok-Fast joints or Fast Grip shall also be used at joints between straight lengths of pipe as shown in the pipe restraint schedule on the Drawings.

E. Ductile iron pressure pipe shall be made of ductile iron of good quality and of such character as shall make the metal casings strong, tough and of even grain and soft enough to satisfactorily permit drilling, tapping and cutting. All piping shall be smooth, free from scale, lumps, blisters, and sand holes and defects of every nature which make it unfit for the use intended. All piping shall be straight and shall be

true circles in section with its inner and outer surfaces concentric. No plugging, filling, burning-in or welding shall be allowed. All piping shall be subject to inspection and approval by the Engineer upon delivery, and no broken, cracked, misshaped or otherwise damaged or unsatisfactory piping will be accepted.

F. Each piece of pressure ductile iron pipe shall have the weight and class designation conspicuously painted on it as near as possible to flange or bell end of the pipe and these designations shall be clearly legible.

G. Wherever ductile iron pipe is specified or shown as having a spigot end, plain end will be acceptable.

H. Where required or shown, the Contractor shall provide ductile iron specials. Specials shall in general consist of spool pieces, less than standard lengths of spigot end, or bell end pipe, or combination of ends, and nonstandard fittings. The specials shall conform in material, thickness and finish to the pipe in which they are installed. Taped reinforced bosses shall be provided as an integral part of fittings, when shown or specified.

I. Where eccentric reducers are indicated to be used, the reducer shall be installed with its straight side at the top of the piping system.

## 2.5 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS (SINGLE WALL)

A. Those piping systems listed in the schedule and where noted on the drawings as being "PVC" shall be unplasticized polyvinyl chloride normal impact type, conforming to ASTM Specifications D-1784 and D-1785 for Class 12454-B. Pipe shall be Schedule 80. Pipe shall be that of the B.F. Goodrich Company, Grinnel Company, Inc., International Pipe and Ceramics Corporation, or equal, and each length shall be clearly labeled with the manufacturer's name, PVC type, schedule and size. Pipe shall be extruded. Welded sets will not be permitted.

B. Fittings shall be VC normal impact type for use with Schedule 80 pipe and shall be as manufactured by Celanese Piping Systems, Inc., or equal. All fittings shall be solid molded. Welded seams shall not be permitted.

C. Generally, all PVC pipe and fittings shall have socket type joints with solvent cement. Joints shall be made in accordance with the manufacturer's instructions. Where specifically noted on the drawings, or where required for connections to equipment for special reasons, pipe and fittings shall have threaded ends, or flanged joints. Threaded joints shall be made using the pipe manufacturer's recommended thread lubricant joint compound. Flanges may be the socket type, and shall be complete with rubber gaskets and galvanized steel bolts and nuts.

D. The Contractor shall demonstrate to the full satisfaction of the Engineer that his personnel are adequately skilled in making the joints specified above, prior to installation of any PVC piping.

E. The County reserves the right to direct the Contractor to have tests conducted on PVC pipe and fittings. These tests, if required, shall be conducted at the manufacturer's plant and shall be at the Contractor's expense. Tests shall be sufficiently complete to prove conformance with the requirements of Commercial Standard CS-256-53, and the following additional quality requirements shall be similarly met:
   1. A parallel plate flattening test to the extent that face to face contact of the interior wall surface is made. The formation of cracks shall be considered failure.
   2. Immersion in a mixture of 15% by volume of dimethyl formamide in anhydrous acetone for twenty (20) minutes. The specimen shall exhibit no visible flaking upon completion of the test.

3. Fittings and couplings shall meet burst pressure requirements of Table 6 of ASTM Specification D1785 for pipe when tested with end plugs inserted to a distance no more than 1/3 of the socket depth.

## 2.6 STEEL PIPE AND FITTINGS

A. General

Steel pipe and fittings shall be provided in accordance with the "Pipe Schedule". All fittings and supports shall be provided as shown on the Drawings. All steel pipe and fittings shall be tested in accordance with AWWA C200. All steel pipe shall be welded in accordance with ANSI/AWWA C206.

B. Materials
1. Pipe and fittings shall be provided by the same manufacturer. Steel pipe shall conform to AWWA C200. Fittings shall conform to AWWA C208. Steel shall conform to ASTM A53, Type E or S.
2. All pipe and fittings shall be rated for 150 psi service.

C. All fabrication and welding shall be performed by certified welders to ASME approved procedure and ASW Standards. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide a cross section of weld metal equal to, or greater than, the parent metal. Inert gas shielding shall be provided to the interior and exterior of the joint. Interior weld beads shall be smooth, even, and not have an interior projection more than 1/6 inch beyond the I.D. of the pipe or fitting.

D. Coatings
1. Interior of all pipe and fittings shall be Portland cement mortar lined in accordance with AWWA C205. The exterior of all pipe and fittings shall be primed and finished painted in accordance with Division 09 91 23 for metal in interior non-immersion service as appropriate.

## 2.7 STAINLESS STEEL PIPE AND FITTINGS

A. All pipe and fittings shall be manufactured and fabricated from stainless steel sheets conforming to ASTM A240-72A. The sheet furnish shall have a mill finish. Pipe and fittings shall be designed for minimum 10 psi operating pressure. Pipes, fittings and specials shall have the following minimum wall thicknesses.

| Diameter (inches) | Schedule |
|---|---|
| < 2 | 40 |
| 2-1/2 to 8 | 5 |
| 10 and 12 | 10 |
| 14 to 20 | 10 |

Pipes shall be joined using factory welds or mechanical couplings of the type specified in this Section.

1. Fittings – elbows 16 inches and smaller will be smooth flow with radius of 1-1/2 times pipe diameter except where due to space restrictions. Elbows 18 inches and larger will be fabricated from five mitered sections of 90 degree with radius of 1-1/2 times pipe diameter except due to space restrictions.
2. Slip-on flanges shall be rolled angle face rings of 316L stainless steel. The rolled angle face shall be true and perpendicular to the axis of the pipe or fitting.
3. Backing flanges for the flanged joints shall be stainless steel and drilled to ANSI B16.1 Class 125.

4. All bolt holes shall straddle normal horizontal and vertical centerlines of flanges unless otherwise noted on drawings.
5. Gaskets shall be all graphite, Grafoil as manufactured by Crane Packing Company or approved equal. Thickness shall be as recommended by the stainless steel pipe manufacturer.
6. All bolts and nuts shall be stainless steel.

B. Pipe and fittings shall be manufactured in accordance with ASTM A778-80 and A774-80, respectively.

C. All fabrication and welding shall be performed in the shop by certified welders to ASME approved procedure and AWS Standards. Field welding shall not be permitted. All welding shall be by the shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide a cross section of weld metal equal to, or greater than, the parent metal. Inert gas shielding shall be provided to the interior and exterior of the joint. Interior weld beads shall be smooth, even, and not have an interior projection more than 1/6 inch beyond the I.D. of the pipe or fitting.

D. After manufacture all pipe, fittings, supports, specials, etc. shall be passivated by immersion in an air agitated pickling tank containing a 10% solution of nitric and hydrofluoric acids for 15 minutes. The acid shall be neutralized by immersion in a rinse tank containing clean water and tri-sodium phosphate.

E. After fabrication, all shop welds shall be wire brushed and scrubbed with the pickling solution, neutralized and washed clean.

F. All stainless steel components shall be handled, transported, fabricated and installed taking care not to make contact with ferrous material; as the contamination of stainless steel by steel may lead to marks caused by rusting of imbedded steel.

G. Joints for pipe, fittings and specials shall be as shown on the drawings or as directed by the Engineer. Backing flanges for the flanged joints shall be stainless steel and drilled to ANSI B16.1 Class 125.

H. Each pipe, fitting and fabrication shall have type, gauge and heat number marked and these designations shall be clearly legible.

I. Certification of all plant tests required under the Standard Specification under which the pipe and fittings are furnished, and certification that such results obtained conform to those specifications, shall be submitted to the City, covering all pipe and fittings delivered to the job.

J. The stainless steel piping shall be as manufactured by Felker Bros. Corp., Douglas Bros., a Division of Robert Mitchell Inc., or approved equal.

K. Spool type expansion joints shall be suitable for 10 psig air service with a temperature range of 0oF to 300oF, 25 psig 60oF test pressure. The tube shall be seamless Nordel (EPT) extending through the bore to the outside edge of both flanges. Caracass shall be flexible Nordel (EPT). Cover shall be neoprene, ANSI 16.5. All expansion joints which are exposed to the weather shall be coated externally with Hypalon paint for protection against sunlight and ozone. Mercer Rubber Company Style 2502EP RM Holz, General Rubber, Metra Flex, or approved equal with galvanized steel retaining rings.

**2.8 CPVC DOUBLE WALL PIPING SYSTEM**

A. The CPVC double wall piping system shall be a pre-fabricated containment piping system as manufactured by (Guardian Systems, MI) Division of IPEX Industrial, or approved equal. The system shall be designed, fabricated, installed and tested in accordance with manufacturer's

recommendations and as specified herein and shall be suitable for the intended service. Manufacturer shall have a minimum of five (5) years experience. Contractor shall not design and or fabricate the piping system.

B. Each contained piping system shall consist of grey Schedule 80 CPVC primary piping system supported within a clear Schedule 40 PVC secondary containment housing. Carrier fitting sizes ½" through 4" will utilize Centra-Lok molded supports minimizing the number of (factory assembled) carrier fitting joints. Each system shall be provided with suitable drains and vents and be designed to provide complete drainage of both the primary and secondary containment piping. Interstitial supporting devices shall be made from Polypropylene Centra-Guide supports and shall be provided within the secondary containment pipe. Supports shall be designed to allow continuous drainage in the annual space to the drain points. Drain fittings shall be designed to allow a valve attachment to be made so that the secondary containment compartment may be readily drained and manually checked for leaks.

C. Materials
   1. The primary pipe and fittings shall be manufactured from Schedule 80 CPVC materials as listed by ASTM and ANSI.

   2. The secondary containment pipe and fittings shall be manufactured from clear Schedule 40 PVC materials as listed by ASTM and ANSI.
   3. All listed primary pipe and containments shall be Schedule 80 materials. Pipe shall have Schedule 80 CPVC pipe thickness. All listed pressure fittings shall be Schedule 80 CPVC according to ASTM D-02467 specifications. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as the equivalent Schedule 40 PVC pipe.
   4. Interstitial supporting devices used to center and support the primary piping within the secondary containment pipe shall be manufactured from molded Polypropylene Centra-Guide supports, according to ASTM and ANSI.
   5. All listed secondary containment pipe and components shall be Schedule 40 materials. Pipe shall have Schedule 40 thickness according to ASTM D-1784. All listed pressure fittings shall be Schedule 40 according to ASTM D-2466. All other unlisted components that are intended for use as pressure retaining components shall have sufficient thickness and reinforcement so as to be able to maintain the same pressure ratings as the equivalent schedule 80 CPVC pipe.
   6. All fittings shall be preassembled (1/2" through 4" carrier fittings will be supported w/Contra-Lok System or approved equal, 6" and larger carrier will be supported with manufacturer's standard polypropylene fitting discs), and pre-tested by the manufacturer.

D. Installation
   1. All installation procedures shall be according to the manufacturer's specific recommendations.
   2. Secondary containment joints shall be solvent-cemented joints using an approved PVC cement ASTM D-2564, made in accordance with ASTM D-2855 procedure. The splitting and rewelding of fittings shall not be permitted.
   3. All contractor personnel that will prepare solvent cemented joints shall be qualified for such bonding practices according to the bonding qualification procedure described in ASME B 31.3, Chapter VII for bonding of plastic piping.

E. Cleaning and Testing

1. Upon completion of the installation, the primary piping system shall be pressure tested at 150% of the system design pressure for a period of one hour. Additionally, the system shall be tested during the installation at intervals to be determined by the manufacturer. All tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such tests.
2. Upon completion of the installation, the secondary containment piping shall be pneumatically tested at a minimum duration of 2-1/2 hours. The external joints should be soaped and visually inspected for leaks. It is imperative that a working pressure regulator be used during the pneumatic test to insure over pressurization of the PVC, beyond 10 psi cannot occur. Also, all precautions should be taken to protect against the hazards of a possible brittle fracture of PVC under compressed gas. Both the preliminary and final test shall be done in strict accordance with the recommendations of the manufacturer, including sequence and duration of such test.
3. Following installation of the systems, the primary piping system shall be flushed clean. The contractor shall check the operation of all valves.

F. Spare Parts
1. Provide two sections of straight pipe, 20 feet in length, each type.
2. Provide two spares of each type of fitting and specialty device used.

## 2.9 COPPER

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.
4) Or Approved Equal.

b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

## 2.10 FLEXIBLE COUPLINGS AND FLANGED COUPLING ADAPTERS

A. Unless specified or shown otherwise on the drawings, flexible couplings shall be the harnessed Dresser Style 38, No. 411 of Rockwell International, or approved equal. Each shall be so harnessed, designed and constructed to withstand an internal line pressure equal to that of the pipeline in which it is to be installed. The various flexible couplings shall be suitable for the class and size of ductile iron pipe or steel pipe as required at the various locations, and shall be without pipe stops. The Contractor shall

provide and install flexible couplings in addition to those shown, as required, for flexibility in installing the various piping systems. Locations of additional couplings shall be as directed by the Engineer.

B. Flanged Coupling Adapters shall be used for joining plain-end pipe to flanged valves, fittings and pumps. Mechanical Joint, ANSI A21.11.

C. Harnesses shall be provided across all flexible couplings and all flanged adapters.

**PART 3 EXECUTION**

**3.1 EXPANSION**

A. The installation of all pipes shall be such as to allow for expansion using expansion joints, as shown on the drawings or as may be necessary to prevent undue strain on piping.

B. Expansion joints shall be flanged end, bellows type. Units shall be of neoprene construction and shall be suitable for use in the service intended. The exterior of the expansion joints shall be suitable for outside service. All units to be provided for use in sludge systems shall have a filled arch. Flanges shall be of hot-dipped galvanized steel construction, with flat-face suitable for mating to ductile iron flanges. Retainer rings shall be constructed of hot-dipped galvanized steel. Expansion joints shall be the Model 500N of Mercer Rubber Company, or approved equal.

**3.2 CONNECTION AT DISSIMILAR METALS**

A. Wherever pipes of dissimilar metal join, there shall be provided an insulating union, coupling or flange connector for corrosion control. Connectors shall include an approved type dielectric separator. Connectors shall be the product of Dresser Corporation, or approved equal. Stainless steel nuts, bolts, and washers shall be used at all places at which such dielectric separators are used.

**3.3 TESTING OF PIPES**

A. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction. All tests shall be made prior to insulating piping.

B. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks or holes will be acceptable. Where it becomes necessary to replace pieces of pipe, the replacement shall be the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good or the work replaced.

C. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage shall result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests.

D. All equipment used in testing shall be subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure test procedures.

E. The test pressure shall be maintained for at least two hours with no pressure drop. All gravity flow piping systems, inside or under the various structures, shall be filled with water and there shall be no drop in level after two hours. Piping systems shall be tested in accordance with the following schedule:

**3.4 AS-BUILT SHOP DRAWINGS**

A. The Contractor shall provide the Engineer with four sets of prints as As-Built Shop Drawings for each interior piping system showing all equipment and valves, together with one set of “mylar” reproducibles. Drawings shall show numbers and/or letters for all equipment and for each valve, as

specified herein under Section 10 14 13 paragraph entitled “Process Equipment, Pipe and Valve Identification Markings.”

## 3.5 JOINTS

A. Joints

1. All joints at equipment shall conform to the equipment requirements. No direct welded connections shall be made to valves or other equipment. Right and left couplings, long screws, or caulking of pipe threads or gasket joints will not be permitted. Mitered joints for elbows and matching straight runs of pipe for tees or elbows will not be permitted.
2. Soldered or brazed joints shall be made with solder and a noncorrosive paste flux. The solder mixture shall be of 95-5 (tin-antimony) content. The use of acid core solder shall not be permitted. The application of excess heat shall be avoided to prevent undue softening or burning of the fittings or tubing when making connections. All soldering operations shall be performed in strict accordance with best accepted practices. Tubing shall be square cut and reamed to remove all burrs. The inside of the fittings and the outside of the tubing at each end shall be well cleaned immediately prior to soldering to remove all traces of oxidation, regardless of how clean the surfaces of the pipe and fittings may appear.
3. Welded joints, if required in the project, shall be made by the electric arc or oxyacetylene gas process. Only thoroughly experienced certified pipe welders shall be employed for the work. The welding wire used shall be coated heavily and shall be of material suitable for making the best possible pipe welds. After being welded, the piping, when tested as specified hereinafter, shall show no indication of leakage, weakness, and other defects. Welding and welders shall be in accordance with the paragraph entitled “Certification of Welders” specified hereinbefore.

Notes

1. Unless noted otherwise in the table below, ductile iron and steel pipe and fittings shall be cement-mortar lined.

| PIPE AND FITTINGS SCHEDULE | | | | | | | |
|---|---|---|---|---|---|---|---|
| SERVICE | DIAMETER RANGE, INCHES | PIPE | | FITTING | | TESTING | |
| | | MATERIAL | JOINT TYPE | MATERIAL | JOINT | MEDIUM | PRESSURE PSIG |
| Influent | 16” | Ductile Iron | Restrained Joint | Ductile Iron | Restrained Joint | Non-Potable Water | 25 |
| Eq influent and Effluent | 8” | Ductile Iron | Restrained Joint | Ductile Iron | Restrained Joint | Non-Potable Water | 25 |
| Drain | 6” | Ductile Iron | Restrained Joint | Ductile Iron | Restrained Joint | Non-Potable Water | 25 |
| MRAS | 4” | Ductile Iron | Restrained Joint | Ductile Iron | Restrained Joint | Non-Potable Water | 25 |
| Drain Line | 3” and Smaller | PVC | Solvent Welded | PVC | Solvent Welded | Non-Potable Water | 10 |
| Utility Water | 4” | Ductile Iron | Restrained Joint | Ductile Iron | Restrained Joint | Non-Potable Water | 100 |
| Utility Water | 3” and Smaller | PVC | Solvent Welded | PVC | Solvent Welded | Non-Potable Water | 100 |
| Process Air | 4”-10” | Stainless Steel | Welded | Stainless Steel | Welded | Air | 15 |
| Potable Water | 3” and Smaller | Copper | Soldered | Copper | Soldered | Potable Water | 100 |
| Alum | 1/2” x 2” | CPVC/PVC | Solvent Welded | CPVC | Solvent Welded | Potable Water | 100 |
| Supplemental Carbon | 1/2” x 2” | CPVC/PVC | Solvent Welded | CPVC | Solvent Welded | Potable Water | 100 |
| Caustic Soda | 1/2” x 2” | CPVC/PVC | Solvent Welded | CPVC | Solvent Welded | Potable Water | 100 |

**END OF SECTION 33 39 13**

# SECTION 33 31 00.14

# EXTERIOR PROCESS VALVES

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Contractor shall furnish and install all exterior process valves as shown on the drawings. The Contractor shall be responsible for the storage, handling and installation of all valves.

B. Related Work Specified In Other Sections.

### 1.2 QUALITY ASSURANCE

### 1.3 SUBMITTALS

A. Provide submittals in accordance with the requirements of Sections 01 33 00.

B. Submittal data shall reference valve identifiers and device tag number for each item of equipment.

C. Quality Control Submittals:
1. Tests and inspection data.
2. Manufacturer's Certification of Proper Installation.
3. Operation and Maintenance Manual.

D. In addition to submitting working drawings for the valves, the Contractor shall obtain and submit to the Engineer certification from the valve manufacturers that the valves meet the requirements of the contract specifications. This certification shall be provided by way of the Equipment Warranty and Certification Form.

## PART 2 PRODUCTS

### 2.1 GENERAL NOTES – VALVES

A. Valves specified herein shall have the type of ends specified or as indicated on the drawings or as required by equipment connections.

B. Non-rising stem valves shall be equipped with valve position indicators.

C. Check valves shall be protected by plug valves so that they may be repaired without removal from the line.

D. Where extension stems are required, they shall be doweled or otherwise securely attached to the valve stem.

E. The valve and operator shall be the responsibility of the valve manufacturer.

F. All valves shall open left, counterclockwise.

### 2.2 PLUG VALVES

A. Eccentric plug valves shall be as manufactured by DeZurick Corporation, or approved equal.

B. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs. All force main valves shall be furnished with mechanical joint connections, AWWA C111. Port areas of all plug valves shall be at least 100% of full pipe area.

C. Valve bodies shall be of ASTM A126, Class B cast iron in compliance with AWWA Standard C504, Section 5.4. All exposed nuts, bolts, springs, washers, etc. shall be stainless steel. Resilient plug facings shall be of neoprene, suitable for use with sewage.

D. Valves shall be furnished with replaceable sleeve type bearings in the upper and lower journals. These bearings shall comply with AWWA Standard C507, Section 8, paragraphs 8.1, 8.3, and 8.5 and with AWWA Standard C504, Section 9.

F. Valve shaft seals shall comply with AWWA Standard C507-73, Section 10, and with AWWA C504, Section 10.

G. Valve pressure ratings shall be as follows and shall be established by hydrostatic tests as specified by ANSI Standard B16-1. Pressure rating shall be 175 psi. Valves shall be capable of providing drip-tight shutoff up to the full rating with pressure in each direction.

H. Valve operators shall be completely enclosed in an air, water, and oil-tight housing mounted directly on the valve and providing access to the valve stem packing. The housing shall comply with AWWA Standard C504, Section 11.2.3 and 11.3. Both worm gear shafts and gear quadrants shall be furnished with replaceable sleeve type bearings the same as the valve bearings. Shaft seals shall be provided to seal all external shafting. All valves shall be completely sealed including the valve stem packing box. Open and closed stops shall be provided to comply with AWWA C504, Section 11.3.

## 2.3 MISCELLANEOUS VALVES

A. All valves shall be provided with the type of ends indicated, unless otherwise specified. All valves of any one classification shall be of the same manufacturer.

B. Unless otherwise specified herein for specific items, valves shall be as follows: equal valves of the Renssalaer Valve Company, Darling Valve and Manufacturing Company or approved equal.
   1. Gate: Stockham Cat. No. B109, soldered ends - 3” and Smaller Soldered-end valves shall be installed with unions adjacent to the valves. In lieu of the combination of soldered-end valves and unions, the Contractor may use screwed union-end type valves.

## 2.4 VALVE BOXES

A. Valves to be direct buried and shall be provided with roadway valve boxes. Roadway valve boxes shall be cast iron and inside riser diameter of 5-1/4” and to be of the two-piece threaded adjustable type with drop cover marked for sewer service and water service as applicable both the inside and outside of the valve box and cover shall be thoroughly cleaned and coated with asphalt varnish, applied hot, before leaving the foundry. Extension stems with standard 2” square operating nuts shall be provided where depth from finished grade to valve operating nuts exceeds 5 feet. Extension stems shall be securely attached to the valve operating nut and shall be provided with means for centering the operating nut within the roadway valve box.

# PART 3 EXECUTION

## 3.1 INSPECTION

A. Inspect for damages immediately before installation. Repair defects before assembly.

B. Assure that bolt holes align before starting assembly.

**3.2 INSTALLATION**

A. As per manufacturers written instructions.

B. Test and demonstrate for proper operation, calibration, and adjustment.

C. The Contractor shall conduct testing in the presence of the Engineer.

**3.3 MANUFACTURER'S FIELD SERVICES**

A. Provide the following services for each different type of power-operated valve assembly or motorized actuator on existing items of equipment:
   1. The actuator manufacturer shall provide representatives for a minimum of one day (or as required to complete the following) during start-up period to:
      a. Inspect, test, calibrate, and adjust all equipment, accessories and controls;
      b. Certify that the equipment installation is complete and ready for operation.
      c. Assist the Contractor to verify that the control system functions and controls the equipment as intended.
      d. Adjust positioners and actuators for proper control with process systems on-line and operating.
      e. Correct any malfunctions appearing during the testing by replacement of defective components or adjustments of maladjusted parts and equipment.
      f. Perform additional testing, as directed by the City, to assure that the replaced or readjusted equipment will perform satisfactorily.
   2. The manufacturer shall start, stop and run all equipment to verify that it is free from defects such as overheating, overloading, undue vibration or noise, leaks, etc.
   3. Upon completion of the tests, the manufacturer shall clean-up all tools, equipment, and debris and provide written certification to the City that the equipment is completely and correctly installed and ready for continuous duty.

B. Provide the following training services for each different type of power-operated valve assembly or motorized actuator installed on existing items of equipment.
   1. Minimum of one day per assembly and actuator type.
   2. Instructor shall be a Manufacturer's technical representative, specifically trained on the specified equipment.

**END OF SECTION 33 31 00.14**

# SECTION 33 39 13

# MANHOLES

## PART 1 GENERAL

### 1.1 SUMMARY

A. The work of this section includes, but is not limited to
   1. Precast Concrete Manholes
   2. Manhole Steps
   3. Manhole Covers and Frames

B. Related Work specified elsewhere
   1. Section 31 23 16 - Trenching, Backfilling & Compacting
   2. Section 33 01 32 - Sewer and Manhole Testing
   3. Section 03 30 00 - Concrete
   4. Section 03 40 00 - Precast Concrete

### 1.2 QUALITY ASSURANCE

A. Standard Specifications for Construction and Materials, Maryland Department of Transportation, State Highway Administration, October 1993 as Amended.

B. American Society for Testing and Materials (ASTM)
   1. A48 - Specification for Gray Iron Castings
   2. B221 - Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
   3. C32 - Specification for Sewer and Manhole Brick
   4. C270 - Specifications for Mortar for Unit Masonry
   5. C478 - Specifications for Precast Reinforced Concrete Manhole Sections
   6. C923 - Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
   7. C990 - Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
   8. D448 - Standard Sizes of Coarse Aggregate for Highway Construction

### 1.3 SUBMITTALS

A. Submit certification from material suppliers attesting that materials meet or exceed specification requirements.

B. Shop Drawings
   1. Submit detailed shop drawings of manhole sections and precast bases.
   2. Submit detailed shop drawings of manhole frames and covers.
   3. Submit detailed shop drawings of manhole steps.

C. Submit manufacturer's descriptive literature and installation instructions for the resilient pipe-to-manhole connection and for the joint sealant compound.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Crushed Stone Subbase: ASTM D448, Size 57

B. Manhole Brick: ASTM C32, Grade MS, Solid.

C. Masonry Mortar: ASTM C270, Type S.

D. Cement Concrete: Section 03 30 00.

## 2.2 MANHOLES

A. Precast Concrete Manhole Sections
   1. Conforming to ASTM C478, with 5.5% + 1% air-entrained cement concrete.
   2. Provide flat slab top sections for manholes less than 4' deep or as indicated on Contract Drawings.
   3. Provide eccentric cone sections for manholes greater than 4' in depth, except as indicated on Contract Drawings.
   4. Provide 30" minimum access opening.
   5. Precast riser sections of length to suit.
   6. Precast bases of a design similar to the precast riser sections.
   7. Factory applied bitumastic coating to manhole exterior.
   8. Prepare surface for coating application in accordance with coating manufacturer's instructions.
   9. Apply coating to minimum 20-mil dry film thickness.

B. Manhole Steps: Aluminum: ASTM B221, Alloy 6061-T6.

C. Manhole Frames and Covers
   1. Cast Iron Castings: ASTM A48, Class 30 or better; free of bubbles, sand and air holes, and other imperfections.
   2. Contact surfaces machined and matched.
   3. Cast cover inscription with pipeline service and, when directed by the Engineer, the Owner's name.
   4. Frame and covers to be 30" in diameter.

D. Joint Sealant shall be D-LOK rubber gasket ASTM C-443 or equal.

E. Pipe-to-Manhole Connection shall be A-LOK per ASTM C923, cast integrally in manhole wall and located as required. Z-LOK may also be used to allow greater deflection (25 degrees).

F. Manhole shall be as manufactured by Atlantic Concrete Products, C.R. Semler or equal. Gaskets shall be as manufactured be A-LOK Corp or equal.

# PART 3 EXECUTION

## 3.1 EXCAVATION

A. Perform excavation to the line and grade indicated on the Contract Drawings and as specified in Section 31 23 16 - Trenching, Backfilling and Compacting.

B. Location and depth of manholes as indicated on the Contract Drawings.

## 3.2 CONSTRUCTION

A. Construct watertight manholes of precast concrete sections of the type indicated on the Contract Drawings.

B. Construct 4' diameter manholes unless otherwise indicated.

C. Provide precast concrete bases.
   1. Install precast bases as shown on Standard Details.
      a. Set the precast base on 6" crushed stone subbase.

b. Provide a sealed, flexible resilient connection between pipe and precast base section.

D. Flow Channels
1. Form flow channels in manhole bases as indicated on the Standard Details.
2. Slope channels uniformly from influent invert to effluent invert, minimum 1" drop.
3. Construct bends of the largest possible radius. Form channel sides and invert smooth and uniform; free of cracks, holes or protrusions.

E. Do not permit pipe to project more than 2" into the manhole.

F. Joint Sealant
1. Seal joints between precast concrete manhole sections with joint sealant compound as indicated on Standard Details.
2. Apply joint sealant compound in accordance with instructions of the manufacturer.
3. Place compound on the interior and exterior sides of the joint to be squeezed out by the weight of the upper section.
4. Trowel sealant compound smooth with manhole interior.
5. Do not apply rigid mortar to the joints between manhole sections.

G. Install manhole sections with steps in proper vertical alignment.

H. Precast Manhole Rings
1. Use precast manhole rings to achieve elevation indicated for frame and cover.
2. Do not adjust elevation more than 1 foot with precast rings.
3. Seal joints between precast rings with joint sealant compound.

I. Install manhole frames and covers.
1. Set top of frames at finished grade elevation or other elevation indicated on the Contract Drawings.
2. Anchor manhole covers installed in unpaved areas as indicated on Standard Detail 5109A.
3. Seal joint between manhole frame and manhole with joint sealant compound.

J. Where new manholes are to be constructed on existing pipelines, carefully excavate around existing pipeline for placement of the new manhole base; take all measures necessary to control flow through the existing pipeline and to prevent leakage into the new base; after completion of the manhole, carefully remove the top portion of the existing pipeline.

## 3.3 BACKFILLING

A. Test manhole as specified in Section 33 01 32 prior to backfilling.

B. Perform backfilling as specified in Section 31 23 16 - Trenching, Backfilling and Compacting.

C. Place backfill in approximately equal lifts on opposite sides of manhole to equalize opposing horizontal pressures.

**END OF SECTION 33 39 13**

# SECTION 33 47 26

# BIORETENTION FACILITY

## PART 1 GENERAL

### 1.1 SUMMARY

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for installing the proposed bioretention facilities and all necessary parts thereof as shown on the Drawings or designated by the ENGINEER.

### 1.2 REFERENCED STANDARDS AND SPECIFICATIONS

A. American Association of State and Highway Transportation Officials (AASHTO)
   1. M-43 – Standard Specification for Sizes of Aggregate for Road and Bridge Construction
   2. M-278, 278 (a) – Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe

B. Maryland Standard Method of Test (MSMT)
   1. MSMT 356 – Sampling and Testing of Landscape Soils

C. Section 32 93 23 – Plants and Bulbs

D. Maryland State Highway Administration (MD SHA) Standard Specifications for Construction and Materials

### 1.3 QUALITY ASSURANCE

A. All materials and aggregates shall conform to specified standards for each material. Written documentation of source of supply and testing completion must be submitted and approved prior to delivery of material. Soils/aggregates shall be a homogenous mixture stored at a specific, identifiable site in an approved stockpile area until future use.

### 1.4 SUMBITTALS

A. Test schedules and source of supply letters must be submitted prior to delivery of materials.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Bioretention Soil Mix (BSM). A homogeneous mixture composed by loose volume of 5 parts Coarse Sand, 3 parts Base Soil, and 2 parts Fine Bark. BSM shall conform to the specifications outlined in MD SHA 920.01.05.

B. No. 7 Stone Aggregate shall conform to AASHTO M-43, No. 7.

C. No. 57 Stone Aggregate shall conform to AASHTO M-43, No. 57.

D. Mulch, Shredded Hardwood Bark shall conform to MD SHA 920.04.03.

E. Pipe, six inch (6”) Polyvinyl Chloride Pipe and Fittings. Pipe used includes perforated and non-perforated. Pipe and fittings shall conform to AASTHO M-278 and/or M-278 (a).

F. Geotextile. Geotextile shall consist of nonwoven, needle-punched continuous filament fabric conforming to MSHA Section 921.09 – Geotextiles, Maryland Application Class SE.

G. Plant materials shall conform to Section 32 93 23 (Plants and Bulbs).

## PART 3 EXECUTION

### 3.1 GENERAL

A. Bioretention facilities are small landscaped basins intended to provide water quality management by filtering stormwater runoff before release into storm drain systems and water ways. This WORK shall consist of installing Bioretention facilities as specified in the Contract Documents or as directed by the ENGINEER, including all materials, equipment, labor and incidentals required to perform the Work.

### 3.2 EXCAVATION

A. Refer to Section 31 23 16 (Trenching, Backfilling and Compacting)

### 3.3 GEOTEXTILE PLACEMENT

A. Place the geotextile on the sides of the prepared excavation as shown on the plans. Where necessary, adjacent edges shall be overlapped at least 2 ft. Replace or repair damaged geotextile as directed.

### 3.4 PERFORATED PIPE SYSTEM

A. The perforated pipe observation wells using six inch (6”) Polyvinyl Chloride Pipe (PVC) shall be placed vertically in the bioretention facility as described in these specifications and shown on the Contract Documents. Observations well shall be placed within a bed of No. 57 stone aggregate and No. 7 stone aggregate as shown in the plans. Perforations shall be made in the PVC pipe at 3/8" diameter at 4" O/C 90 degrees all around pipe. PVC pipe shall be perforated only to the depth of the stone aggregates. Observation well pipe sections through bioretention media shall be solid (non-perforated).

B. The ends of pipes not terminating in a cleanout, vent or drainage structure shall be capped. The cap shall be a watertight, removable, screw top.

C. All aggregate shall be clean and free of all soil and fines. Care shall be taken to prevent soil and fines from intermixing with the aggregate. All contaminated aggregate shall be removed and replaced with uncontaminated aggregate at no additional cost to the County.

### 3.5 BIORETENTION SOIL MIXTURE (BSM)

A. The BSM shall be placed in horizontal layers not to exceed 12 inches (12”) for the entire area of the Bioretention Facility. The BSM shall be compacted by saturating the entire area of the Bioretention Facility after each lift of BSM is placed until water flows from the perforated pipe system. Water for saturation shall be applied by spraying or sprinkling. Saturation of each lift shall be performed in the presence of a County representative. An appropriate sediment control device shall be used to treat any sediment laden water discharged from the perforated pipe system. If the BSM becomes contaminated during the construction of the facility, the contaminated material shall be removed and replaced with uncontaminated material at no additional cost to the County. Final grading of the BSM shall be performed after a twenty-four (24) hour settling period. Final depths shall be as shown on plans.

### 3.6 MULCHING

A. Once the plants are in place, the entire Bioretention Facility shall be mulched to a uniform thickness of three inches (3”). Well-aged (minimum age of six (6) months) shredded hardwood bark mulch is the only acceptable mulch. If plants cannot be installed into the facility within forty-eight (48) hours of final facility grading, the entire facility shall be temporarily stabilized with mulch at a uniform thickness of one inch (1”).

**3.7 PLANTS**

A. Plants shall conform to the specifications in Section 32 93 23 Plants and Bulbs

**END OF SECTION 33 47 26**

**SECTION 40 23 19**
**PIPE AND PIPE FITTINGS**

## PART 1 - GENERAL

### 1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:
   1. Pressure Flow Yard Piping
   2. Wastewater Treatment Process Piping

B. Related Work Specified Elsewhere:
   1. Section 31 23 17 - Trenching, Backfilling and Compacting
   2. Section 33 40 00 - Site Drainage
   3. Section 40 23 20 - Valves and Piping Specialties
   4. Section 40 23 21 - Testing Piping Systems

### 1.2 QUALITY ASSURANCE

A. Install piping to meet the requirements of state and local building codes.

B. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.

C. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Referenced Standards:
   1. American Society for Testing and Materials (ASTM):
      a. D283 Test Method for Resistance of Porcelain Enameled Utensils to Boiling Acid
      b. D792 Test Method for Density and Specific Gravity (relative Density) of Plastics by Displacement
      c. D5162-01 Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Shop Drawings and Product Data: Submit shop drawings and manufacturer's catalog information for pipe materials, including but not limited to
   1. Piping layout
   2. Pipe hangers, supports, guides and anchors
   3. Pipe wall sleeves and seals
   4. Pipe coupling adapters

C. Grooved joint couplings and fittings shall be shown on drawings and products submittals and shall be specifically identified with the applicable Victaulic style or series designation.

D. Manufacturer's Instructions: Submit manufacturer's instructions for installation of adapters and assembly of mechanical and push-on joints, including the manufacturer's maximum recommended deflection per joint.

E. Certificates: Submit certification, Section 00 62 33.14, from each product manufacturer attesting that the pipe, pipe fittings, joints, joint gaskets and lubricants meet or exceed specification requirements.
F. Pipe and Bedding Classes: Submit a system map indicating the material and class of pipe and the bedding type to be used.

### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting, unloading, and storage on site, exercise care to prevent damage to piping materials.
B. Do not drop pipe or fittings.
C. Store materials on site in enclosures or under protective coverings.
D. Assure that materials are kept clean and dry; do not store materials directly on the ground.

## PART 2 - PRODUCTS

### 2.1 POLYVINYL CHLORIDE (PVC) SEWER PIPE

A. Gravity Sewer Pipe and Fittings:
   1. Pipe 15" Diameter and Smaller: ASTM D3034, SDR-35
   2. Pipe 18" to 27" Diameter: ASTM F679, SDR-35
   3. Flexible Elastomeric Seals: ASTM D3212
   4. Seal Material: ASTM F477
B. PVC Pressure Sewer Pipe and Fittings - 12" Nominal Pipe Size and Smaller:
   1. PVC shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, normal impact-inch pipe, Schedule 80.
   2. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Contract Drawings. Plastic piping shall be installed in full accordance with the manufacturer's recommendations for the specific installation. No field bending or distortion of the pipe will be permitted.
   3. For pipe sizes smaller than 4-inch; utilize socket type joints.
   4. PVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D 1784 and ASTM F 441. CPVC fittings shall be socket type conforming to ASTM F 439.
   5. Provide flanged fittings of the same material as the specified pipe and material conforming to ANSI B16.5 at all valves and equipment with Teflon filled or natural rubber gaskets. Bolts shall be type 316 stainless steel for flanged joints. Flanges are not required at true (double) union valves.
   6. Solvent cement for socket type joints shall conform to ASTM F 493 for PVC and CPVC pipe and fittings. Solvent cement shall be Weldon - 724 as manufactured by IPS Corporation.
   7. Basic Piping Materials: All piping material must be compatible with the chemicals to be fed. Support all piping as required.

### 2.2 STEEL PROCESS PIPE

A. Pipe:
   1. ASTM A134, straight seam, electric fusion arc-welded. [pipe larger than 16"]
   2. ASTM A135, electric resistance welded pipe, Grade (A) (B). *Grade A (Flanging and Bending) [pipe size 2" - 30"]
   3. ASTM A139, electric fusion (arc) welded steel pipe, Grade B. [size 4" and over]

B. Fittings:
   1. ASTM A105, forgings, carbon steel, for piping components
   2. ASTM A 181, forgings, carbon steel, for general purpose piping, Class 70
C. Shop Coatings - Pipe, Fittings and Flanges: Minimum SSPC-SP6 with SSPC-Paint 20, Type II, organic zinc-rich primer.

**2.3 STAINLESS STEEL PIPE**

A. Pipe: Welded; ASTM A312, TP 304L; and ANSI B36.19, Schedules 5S, 10S and 40S, as indicated on the Drawings.
B. Fittings:
   1. ASTM A403, WP 304L.
   2. Vic-Press 304 precision, cold drawn, austenitic stainless steel for pipe sizes 2" and smaller with Schedule 5S stainless steel pipe.
C. Joints: Welded, flanged (Vic-Press 304) or threaded as indicated on the Drawings. All flanges shall be stainless steel. All bolts shall be stainless steel.

**2.4 BLACK AND GALVANIZED STEEL PIPE (GENERAL USE)**

A. Pipe: ASTM A53, Seamless. Schedule 40, unless otherwise indicated on the Contract Drawings.
B. Fittings:
   1. Threaded: Malleable Iron, ANSI B16.3, 150# Class
   2. Flanged: Cast Iron, ANSI B16.1, 125# Class
   3. Socket Welded: Forged Steel, ANSI B16.11
C. Flanges: AWWA C 207.
D. Unions: Threaded, Forged Carbon Steel, MSS SP-83.

**2.5 FLEXIBLE POLYETHYLENE PIPE**

A. Pipe and fitting shall conform to ASTM D3350, SDR 9, ASTM D3035, ASTM F714 and ASTM D3350. NSF 14 and AWWA C901 - C906 approved. Pressure rating 200 PSI.
B. Fittings shall be of the butt heat fusion type.
C. Pipe and fittings shall have a minimum working pressure rating of 170 psi at 73 degrees F for compressed air service.
D. Provide test reports verifying pipe compliance in regards to materials, dimensions, and pressure rating.

**2.6 BRAIDED REINFORCED PVC TUBING**

A. Flexible hose shall be extra heavy-duty flexible vinyl reinforced PVC with a rigid PVC spiral helix. Hose interior shall be smooth. Provide with necessary couplings or adapters as shown on the Contract Drawings. Hose shall meet the following criteria:
   1. Braided
   2. Crystal clear
   3. Non-toxic, DEHP & plasticizer-free
   4. Wall thickness: 0.114 inches
   5. Working minimum pressure @ 70°F: 215 psi
   6. Durometer hardness (shore A): 80 ±5

7. Temperature range: -50°F to 175°F (for NSF 140°F)30 psi minimum pressure rating and a 29" H.G. minimum vacuum rating.

**2.7 PIPE ACCESSORIES**

A. Wall Sleeves and Wall Pipes:
   1. Cast Iron: ASTM A48, Class 30B
   2. Ductile Iron: ASTM A536, Grade 60-40-18
   3. Mechanical Joint, ANSI/AWWA C111/A21.11
   4. Integral cast intermediate wall collar

B. Wall Seals:
   1. Assembly of synthetic rubber links connected with corrosion resistant bolts; when the bolts are tightened, Delrin plastic pressure plates compress the rubber links to fill the annular space between the pipe and the wall sleeve to form a watertight seal.
   2. All wall seals located in penetrations through new walls that are below grade shall be installed in a cast iron wall sleeve that conforms to the requirements of this specification section or installed in a steel wall sleeve. This steel wall sleeve shall consist of a piece of standard weight steel pipe with an integral steel anchoring collar. This anchoring collar shall be 1/4" thick, shall project 3" beyond the pipe outer wall and shall be welded to the pipe around its entire periphery. No sleeves are required if hole is core drilled through a new or existing concrete wall.
   3. Century-Line prefabricated sleeves as manufactured by the Thunderline Corporation, Belleville, Michigan may be used in lieu of steel or cast iron sleeves for wall seal application.

C. Flange Adapters:
   1. For connecting plain-end pipe to flanged valves, fittings and pumps, constructed of ductile iron with 125 lb. flange drilling; anchor to plain-end pipe by means of setscrews conforming to ANSI B16.1. Provide with Buna-N gasket. Temperature range -20 degrees F to 150 degrees F; working pressure a follows:
      a. 2" to 12" - 175 psi
      b. 14" to 24" - 150 psi
      c. 30" to 48" - 100 psi
   2. Setscrews shall prevent pullout up to working pressure specified plus 100 psi surge pressure.

D. Flange Coupling Adapters:
   1. For joining plain-end pipe to flanged valves, fittings and pumps.
   2. Mechanical Joint, ANSI/AWWA C111/A21.11. Provide all flanged coupling adapters with anchor studs.
   3. Split-Sleeve Type: Victaulic Depend-O-Lok Flg x E Adapter.

E. Couplings (Interior):
   1. Factory pre-assembled couplings for plain-end pipe.
   2. Sleeve: Carbon steel, minimum yield of 30,000 psi.
   3. Followers: Steel
   4. Bolts and Nuts: High-strength, low-alloy steel with heavy, semi-finished hexagon nuts.
   5. Gaskets: Grade 60
   6. Finish: Enamel
   7. Anchor studs

8. Manufacturer: Smith-Blair, Type 411, or equal.

F. Couplings (Buried Service):
   1. Sleeve Type:
      a. Factory pre-assembled couplings for plain-end pipe.
      b. Sleeve: Ductile iron
      c. Followers: Ductile iron
      d. Bolts and Nuts: Stainless steel
      e. Gaskets: Grade 60
      f. Finish: Fusion bonded epoxy
      g. Manufacturer: Smith-Blair, Type 441, or equal.
   2. Split Sleeve Type:
      a. Body: Carbon Steel (ASTM A36) or Stainless Steel (ASTM A240).
      b. Restraint Rings: Required for 'fixed' joints only. Carbon Steel (ASTM A108) or Stainless Steel (ASTM A276).
      c. Bolts and Nuts: Electroplated carbon steel or stainless steel.
      d. Gaskets: O-ring type, elastomer grade to suit intended service.
      e. Finish: Fusion bonded epoxy.
      f. Manufacturer: Victaulic Depend-O-Lok FxF, ExE, or FxE, or equal.

G. Transition Couplings (Interior):
   1. Factory pre-assembled couplings for plain-end pipe.
   2. Sleeve: Carbon steel, minimum yield of 30,000 psi.
   3. Followers: Steel
   4. Bolts and Nuts: High-strength, low-alloy steel with heavy, semi-finished hexagon nuts.
   5. Gaskets: Grade 60
   6. Finish: Enamel
   7. Manufacturer: Smith-Blair, Type 413, or equal.

H. Transition Couplings (Buried Service):
   1. Sleeve Type:
      a. Factory pre-assembled couplings for plain-end pipe.
      b. Sleeve: Ductile iron
      c. Followers: Ductile iron
      d. Bolts and Nuts: Stainless steel
      e. Gaskets: Grade 60
      f. Finish: Fusion bonded epoxy
      g. Manufacturer: Smith-Blair, Type 441, or equal.
   2. Split Sleeve Type:
      a. Body: Carbon Steel (ASTM A36) or Stainless Steel (ASTM A240).
      b. Restraint Rings: Required for 'fixed' joints only. Carbon Steel (ASTM A108) or Stainless Steel (ASTM A276).
      c. Bolts and Nuts: Electroplated carbon steel or stainless steel.
      d. Gaskets: O-ring type, elastomer grade to suit intended service.
      e. Finish: Fusion bonded epoxy.
      f. Manufacturer: Victaulic Depend-O-Lok FxF, ExE, or FxE, or equal.

I. Reducer Couplings (Interior):
   1. Factory pre-assembled couplings for plain-end pipe.
   2. Sleeve: Carbon steel, minimum yield of 30,000 psi.
   3. Followers: Steel
   4. Bolts and Nuts: High-strength, low-alloy steel with heavy, semi-finished hexagon nuts.
   5. Gaskets: Grade 60
   6. Finish: Enamel
   7. Manufacturer: Smith-Blair, Type 415, or equal.

J. Reducer Couplings (Buried Service):
   1. Factory pre-assembled couplings for plain-end pipe.
   2. Sleeve: Ductile iron
   3. Followers: Ductile iron
   4. Bolts and Nuts: Stainless steel
   5. Gaskets: Grade 60
   6. Finish: Fusion bonded epoxy
   7. Manufacturer: Smith-Blair, Type R441, or equal.

## 2.8 CONTAINMENT CONDUIT PIPING SYSTEMS

A. General: Containment conduit piping systems include carrier piping and fittings, secondary-containment conduits and fittings, centering spacers in annular space between carrier pipe and inside of conduit, and liquid-tight joints. Conduits and spacers are arranged so that system can be vented and drained and space is available for installing leak detection cable. Containment conduit material is made of corrosion resisting material or has corrosion resisting coating.

B. Containment conduit piping system sizes refer to carrier pipe sizes.

C. Include system manufacturer's standard fittings, terminal pieces, and accessories.

D. Glass-Fiber-Reinforced Thermosetting Resin (RTRP) Containment and Carrier Piping Systems: UL-listed, ASTM D 2996 or ASTM D 2997, RTRP carrier pipe, RTRP outer conduit, and RTRP double-wall fittings. Provide following carrier pipe for sizes less than 2 inches.
   1. Carrier pipe includes:
      a. Steel Pipe: ASTM A 53, Schedule 40, Type S (seamless) or Type E (electric resistance welded), Grade A or B, black, with beveled ends.
      b. Steel Pipe Fittings: ASTM A 234/A 234M, seamless or welded; ASME B16.9, butt welding type; and ASME B16.11, socket welding type, for welded joints.

E. Underground Containment Conduit Piping Systems:
   1. PermAlert - Environmental Specialty Products, Inc.
   2. A.O. Smith Fiberglass "Red Thread IIA".
   3. Ameron "Dualoy 3000/L" Fiberglass.

## 2.9 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

1. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
2. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
3. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   a. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
4. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
5. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

**2.10 DISMANTLING JOINTS**

A. Flange Spool: AWWA Class D flange compatible with ANSI Class 125 and 150 bolt circles. For 3’ - 12” sizes, pipe is Schedule 40 ASTM A53. For 14’ - 24” pipe materials are ASTM A36.
B. Body: ASTM A536 ductile (nodular) iron meeting or exceeding Grade 65-45-12 with ANSI Class 125 and 150 bolt circles.
C. Gaskets: ASTM D 2000.
D. Restraining Bolts: 7/8 -9 roll thread, ductile (nodular) iron, meeting or exceeding ASTM A536.
E. Restraining Lugs: Ductile (nodular) iron, meeting or exceeding ASTM A536.
F. Lug Locators: Polyurethane, a thermal plastic.
G. T-bolts and Nuts: High strength low alloy steel T-head bolt. National coarse rolled thread and heavy hex nut. Steel meets AWWA C111 composition specifications.
H. Coatings: Fusion bonded epoxy, NSF 61 certified.
I. Manufacturer: Romac Industries, Inc., Model DJ405, or equal.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Perform trench excavation to the line and grade indicated on the Contract Drawings and as specified in Section 31 23 17, Trenching, Backfilling and Compacting.
B. Unless otherwise indicated on the Drawings, provide a minimum cover of 4'-0" above the top of piping laid in trenches.
C. Provide pipe bedding as specified in Section 31 23 17 for each type of pipe used.
D. Provide Type IV bedding for all PVC and other plastic pipe. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

**3.2 LAYING PIPE IN TRENCHES**

A. Give ample notice to the Engineer in advance of pipe laying operations.
B. Use laser alignment equipment during pipe laying operations.

C. Lower pipe into trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to the pipe; do not drop pipe.
D. Lay pipe proceeding upgrade with the bell or groove pointing upstream.
E. Lay to a uniform line with the barrel of the pipe resting solidly in bedding material throughout its length; excavate recesses in bedding material to accommodate joints, fittings and appurtenances; do not subject pipe to a blow or shock to achieve solid bedding or grade.
F. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.
G. Pipe Joining:
    1. Clean and inspect each pipe and fitting before joining; assemble to provide tight, flexible joints that permit movement caused by expansion, contraction and ground movement.
    2. Use lubricant recommended by the pipe or fitting manufacturer for making joints.
    3. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the bell, disassemble joint, inspect for damage, reclean joint components, and reassemble joint.
H. Assemble mechanical joints in accordance with ANSI/AWWA C111/A21.11, Appendix A; if satisfactory seating of the joint is not obtained at maximum torque, disassemble the joint, reclean, and reassemble using a new gasket.
I. Push-On Joints:
    1. Assemble push-on joints in accordance with the recommendations of the pipe manufacturer.
    2. On field-cut pipe, file or grind the spigot to resemble the pipe as manufactured so that the spigot end will slip into the socket intact without hindrance or cause gasket damage.
    3. Install spigot end to full depth of socket.
    4. Prior to installation, mark the spigot end of field-cut pipe with the insertion depth.
J. Split-sleeve couplings shall be installed in accordance with manufacturer's latest installation instructions. In no case shall the deflection in the joint exceed the maximum deflection recommended by the manufacturer.
K. Check each pipe installed as to line and grade in place; correct deviation from grade immediately; deviation from the designed grade and alignment as indicated on the Contract Drawings will be cause for rejection.
L. Do not deflect joints in pressure piping more than the maximum recommended by the pipe manufacturer.
M. Place sufficient backfill on each section of pipe, as it is laid, to hold pipe firmly in place.
N. Clean the interior of the pipe as the work progresses; where cleaning after laying is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull forward past each joint immediately after joining has been completed.
O. Keep trenches and excavations free of water during construction.
P. When the work is not in progress, and at the end of each workday, securely plug ends of pipe and fittings to prevent trench water, earth or other substances from entering the pipe or fittings.

**3.3 THRUST RESTRAINT**

A. Provide pressure pipeline with restrained joints or concrete thrust blocking at all bends, tees, and changes in direction; construct concrete thrust blocking in accordance with Standard Details 5195 and 5196. If restrained joints are utilized, submit design calculations showing determination of restrained

lengths and submit joint restraint details. Method of joint restraint shall utilize devices specifically designed for the application for which manufacturer's data is available for the application. Submit manufacturer's literature for approval.

**3.4 CRADLES AND ENCASEMENT**

A. Provide concrete cradle and encasement for pipeline where indicated on the Contract Drawings; construct in accordance with Standard Detail 5179.

**3.5 BACKFILLING TRENCHES**

A. Backfill pipeline trenches only after examination of pipe laying by the Engineer.
B. Backfill trenches as specified in Section 31 23 17, Trenching, Backfilling and Compacting.

**3.6 UTILITY MARKING TAPE**

A. Install detectable utility marking tape as specified in Section 31 23 17 above all plastic pressure pipelines, 12"-18" below final grade.

**3.7 INTERIOR PROCESS PIPING INSTALLATION**

A. Pipe Layout in Buildings:
   1. Coordinate work to prevent interference between architectural, structural, electrical and mechanical features; the Contract Drawings are generally diagrammatic due to their small scale.
   2. Provide such offsets, fittings and other items as may be required to suit conditions.
   3. Do not place joints or fittings over switchboards, panels, motors or other electrical equipment.
   4. The completed installation shall present a neat, orderly appearance; do not block openings or passageways; run piping parallel to the walls of buildings or structures.
   5. Provide clearance between piping, walls, floors, machinery and equipment to prevent the transmission of noise and vibration.
   6. Orient handwheels, levers, valve operators and other valve actuators for convenience of operation; set gate valves with the stem above the horizontal.
   7. Cut pipe to measurements established at the site and install without springing or forcing; make changes in direction with fittings.
   8. Connect ferrous piping to non-ferrous piping with dielectric couplings.
B. Equipment Connections:
   1. Make connections to pumps and other equipment in a manner to eliminate strains on piping and equipment.
C. Wall Sleeves and Wall Pipes:
   1. Provide pipes passing through concrete construction with wall sleeves or wall pipes having an integral cast or welded intermediate wall collar, as indicated on the Contract Drawings.
   2. Set wall sleeves and wall pipes of the required size during construction of the wall, foundation or slab.
D. Wall Seals:
   1. Provide watertight wall seals between pipe and wall sleeve where pipes penetrate building walls, foundations or slabs.
   2. Annular space between pipe and wall sleeve shall be sealed with mechanical seal consisting of interlocking synthetic rubber links shaped to fill the space and assembled with bolts and a

pressure plate under each bolt head and nut, and when squeezed the rubber links shall form a watertight seal with the pipe sleeve.

E. Flanged Joints:
   1. Tighten flange bolts so that the gasket is uniformly compressed and sealed; do not distort flanges; do not exceed manufacturer's recommended maximum torque.
   2. Leave flange bolts with ends projecting 1/8" to 1/4" beyond the face of the nut after tightening.

F. Flange Adapters and Flange Coupling Adapters:
   1. Flange Adapters: Tighten flange adapter setscrew with torque wrench to manufacturer's recommended tightening torque.
   2. Flange Coupling Adapters: Drill hole in plain-end of process pipe at each anchor stud location. Tighten anchor stud fully so that anchor stud protrudes into drilled hole thereby preventing lateral movement of the pipe.

G. Solder Joints:
   1. Ream or file pipe to remove burrs; clean and polish contact surfaces of joints.
   2. Apply flux to both male and female end; insert end of tube into fittings full depth of socket.
   3. Bring joint to soldering temperature, in as short a time as possible, forming continuous solder bead around entire circumference of joint.

H. Solvent Cemented Joints (PVC): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2855.

I. Fusion Welded Joints (PE): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2657 or ASTM D3261 as applicable.

J. Butt Welded Joints (Stainless Steel): All pipe welding shall comply with the American National Standard Code for pressure piping, ANSI B31.3, and with AWS D10.4. All welders and welding procedures shall be qualified in accordance with ASME Code, Section IX, Welding and Brazing, and with AWS D10.9 and B2.1 qualifications at the Contractor's expense. Welders shall be qualified on the 6G position or both the 2G and 5G positions. Welding shall be performed by the TIG or short-arc M16 method.

## 3.8 PIPE SUPPORTS

A. Support piping from structural construction using pipe hangers, pipe riser clamps and pipe clamp hangers in conjunction with beam clamps, brackets or other equipment as dictated by structure construction.

B. Trapeze hangers approved by the Engineer may be used where several horizontal pipes run closely parallel; secure pipes on trapeze hangers to prevent sideway motion.

C. Install supports for piping 2-1/2" and greater in diameter in accordance with details indicated on the Contract Drawings; support piping under 2-1/2" diameter as specified herein.

D. Vertical Piping:
   1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.
   2. Support vertical iron and steel pipe on maximum 5'-0" centers with steel pipe riser clamps.
   3. Support vertical copper tubing at no more than 10'-0" spacing, using plastic coated steel pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.
   4. Support vertical plastic pipe at 4'-0" centers, using plastic coated pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.

E. Horizontal Piping:
   1. Support at sufficiently close intervals to prevent sagging, thrust restraint, and vibration.
   2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.
   3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10'-0" centers.
   4. Install steel clevis-type pipe hangers for copper tubing on 6'-0" centers for 1-1/4" size and smaller, and on 10'-0" centers for copper tubing larger than 1-1/4" size. Install plastic coated ring-type pipe hangers for horizontal plastic pipe on maximum 4'-0" centers, close to every joint, at ends of each branch, and at each change in direction of elevation; hangers shall not compress, distort, cut or abrade plastic piping and shall permit free movement of the pipe.

F. Pipe Bracing: The Contractor is responsible for properly bracing piping against lateral movement or sway. The Engineer shall review with the Contractor and approve method of bracing of piping at each location prior to Contractor proceeding with the installation of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by the Engineer.

**3.9 CUTTING AND PATCHING**

A. Do not cut and patch existing structures without prior permission from the Engineer.
B. Perform cutting and patching where indicated in the Contract Drawings. Patch to match adjacent finishes.

**3.10 TESTING**

A. Test piping systems as specified in Section 40 23 21.

**END OF SECTION 40 23 19 40 23 19**

**SECTION 40 23 20**
**VALVES AND PIPING SPECIALTIES**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:
   1. Provide and install all valves, hose connections, hydrants, valve boxes, and other piping specialties as specified, as indicated on the Contract Drawings, and as necessary to provide complete piping systems as intended.

B. Related Work Specified Elsewhere:
   1. Section 40 23 19 - Pipe and Pipe Fittings

### 1.2 QUALITY ASSURANCE

A. Products shall be new, the latest standard product of reputable manufacturers, and shall have replacement parts available.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Shop Drawings and Product Data:
   1. Submit manufacturer's catalog data, literature, illustrations and specifications.
   2. Submit shop drawings of valves and valve operators including dimensions, net assembled weight of each size valve furnished, construction details, and materials of components.
   3. Submit manufacturer's installation instructions.
   4. Submit manufacturer's maintenance instructions and complete parts lists.

C. Certificates:
   1. Submit a Certificate of Compliance, Section 00 62 33.14, together with supporting data, from the materials supplier(s) attesting that valves, accessories, and specialties meet or exceed specification requirements.

### 1.4 FIELD SERVICES

A. Provide the services of the motorized valve actuator manufacturer's representative experienced in the installation and operation of the equipment supplied under this specification for adjustment of valve limit switches, torque switches and positioning, installation inspection, and instructing Owner's personnel.

### 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver valves and accessories to the job site in the manufacturer's boxes or crates. Mark each valve as to size, type and installation location.

B. Seal valve ends to prevent entry of foreign matter into valve body.

C. Store valves and accessories in areas protected from weather, moisture and possible damage.

D. Do not store materials directly on the ground.

E. Handle valves and accessories to prevent damage to interior and exterior surfaces.

### 1.6 JOB CONDITIONS

A. Investigate conditions affecting this work and coordinate with other contractors to prevent interference between architectural, structural, mechanical and electrical features.
B. The Contract Drawings for small diameter pipe are generally diagrammatic and it is not possible to indicate all fittings, valves, and other items required for a complete operating system. Provide all such valves, fittings and specialties to complete the systems as intended.
C. Provide necessary valve wheels, keys, wrenches, levers and stem extensions. Locate to assure accessibility and operability throughout the operating range without interference. Install valve stem supports, guides and operators. For buried valves, provide valve boxes and stem extensions to grade. Provide valve accessories of the same manufacturer as the valve, unless specified otherwise.
D. Provide chain operators for valves 4" size and larger that are located 6'0" or more above finished floor level.

## PART 2 PRODUCTS

### 2.1 GENERAL

A. Provide valves and piping specialties of the size and type indicated on the Contract Drawings.
B. Cast iron valve material shall meet or exceed the requirements of ASTM A126, Class B.
C. Valve flanges shall conform to ANSI B16.10, (125 pound and 250 pound Class) as applicable.
D. Mechanical joint valve ends shall conform to ANSI/AWWA C111/A21.11.
E. Valves shall be of a design that requires no more than 50 lbs pull on the handwheel or standard valve wrench to provide positive shutoff against rated working pressure.

### 2.2 GATE VALVES

A. Resilient Seated:
   1. Flanged, mechanical joint or push-on joint.
   2. Iron body, ASTM A126, Class B; non-rising bronze stem, ASTM B584.
   3. Gate (4", 6", 8" Buna S encapsulated cast iron, A126, Class B: 10", 12" Buna S encapsulated ductile iron, A536, Grade 65-45-12).
   4. O-ring of Buna N. ANSI/AWWA C515; valve body, inside and out, to be coated in accordance with AWWA C550; 250 psi working pressure. Open counterclockwise.
B. Gate valves to be manufactured by American Flow Control Series 2500, or equal.

### 2.3 CHECK VALVES

A. Heavy-Duty Outside Lever and Weight Swing Check Valves:
   1. The valves shall exceed the minimum requirements of AWWA C508 with a heavy duty body of high-strength cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125, suitable for horizontal or vertical installation. Check valves shall have a 150 psi minimum working pressure rating.
   2. The valve body shall be the full waterway type, designed to provide a net flow area not less than the nominal inlet pipe size when swung open no more than 25 degrees. The valve shall have a replaceable stainless steel body seat, a cast iron disc faced with a renewable resilient seat ring of rubber or other suitable material and held in place by stainless steel screws.
   3. The disc arm shall be ductile iron or steel, suspended from and keyed to an austenitic stainless steel shaft which is completely above the waterway and supported at each end by heavy bronze

bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.

4. Provide check valves designed so that all parts may be removed for inspection or replacement through the top of the valve with the valve in position.
5. The valve shall be supplied with a weight to assist valve closure. Weight location shall be adjustable.
6. Manufacturer: The valve shall be G. A. Industries, Inc., Figure 230-DS, or equal.

B. PVC Check Valves:
1. Use on all plastic piping. Double union ball type, Viton seats. 150 psi working pressure. Ball positively retained.

C. Pinch Tube Type Check Valves:
1. Check valves shall be of "duck bill" shaped pinch tube type with stainless steel body, neoprene pinch tube sleeve, female NPT ends, and a 75 psi minimum working pressure rating. Provide PVC plug for gage tap. The check valve shall have removable end caps to allow sleeve replacement.
2. Check valve shall be Tideflex Series 2633 as manufactured by the Red Valve Company, or equal.

D. Rubber Flapper Check Valves:
1. Flanges joint check valve with a valve body that has full flow equal to nominal pipe diameter at any point. The seating surface shall be on a 45 angle to minimize disc travel. The top access port shall be full size, allowing the removal of the disc without removing the valve from the pipe line. The disc shall be Buna-N (NBR) ASTM D2000-B6. The disc shall be of one piece construction, precision molded with an integral O-ring type seating surface and contain steel and nylon reinforcements in the central disc areas. Valve shall have a 150 psi working pressure rating and shall be provided with 125 lb. flanges. Valves with a minimum of a 175 psi working pressure rating shall include disc accelerator. Mechanical indicator and backflow actuator shall be included where required.
2. The valve body and cover shall be ASTM A126, Class B cast iron.
3. The interior of the valve shall be coated with epoxy. The exterior shall be coated with universal primer. The check valve shall be rubber flapper check valve as manufactured by Valmatic Company, or equal.

E. Provide check valves designed so that all parts may be removed for inspection or replacement through the top of the valve with the valve in position.

## 2.4 PLUG VALVES

A. Iron body, flanged or mechanical joint ends. Eccentric plug, rectangular or semi-circular ports. For 4" diameter and smaller plug valves, where rectangular port is furnished and the valve is utilized for a sewage or sludge application, the cross-sectional area shall be not less than 100% of the connecting pipe cross-sectional area. All plug valves provided for this project shall be provided by the same manufacturer, and shall conform to AWWA C517.

B. Plug valves shall have a cast iron plug having a resilient nitrile, neoprene, EPDM, fluoroelastomer or Buna-N coating. Valve bodies shall be furnished with an 1/8" minimum welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Valves shall have corrosion resistant bearing. Valve shaft seals shall be in accordance with AWWA C504 or C507. Valve housing shall be constructed such that a

leak through the shaft seal is free to drain to atmosphere and will not flood the gear actuator. Valves shall have a 150 psi working pressure. Sizes 4" and smaller lever actuated; sizes 6" and larger provide with manual handwheel gear actuators.

C. Gear Actuators:
   1. Gearing oil lubricated, enclosed in a semi-steel sealed housing. Actuator shaft and quadrant supported on permanently lubricated bronze bearings. Stainless steel nuts, bolts, springs and washers.
   2. Valve position indicator. Adjustable closing torque stop.
   3. Mounting brackets for buried or submerged service totally enclosed and with gasket seals.

D. Motor Gear Actuators:
   1. Provide valves with motor gear actuators when indicated on the Contract Drawings. Motorized gear actuators shall incorporate bronze worm gearing, heavy-duty anti-friction bearings, aluminum or steel housing, and declutchable manual override handwheel. Actuator mounting, sizing and testing shall be performed by the valve manufacturer. Motor gear actuator sizing shall be based on the plug valve full working pressure rating for bi-directional flow service. Control valve assembly shall be provided as a control valve unit with the responsibility to be that of the valve manufacturer.
   2. The motor shall be 460 V, 3 phase specifically designed for valve actuator service and shall be of high torque, totally enclosed, non-ventilated construction, with motor leads brought into the limit switch compartment without having external piping or conduit box. Motor insulation shall be NEMA Class B with a maximum continuous temperature rating of 120 C (rise + ambient). The motor shall be of sufficient size to open or close the valve against the maximum expected differential pressure when voltage to the motor terminals is 10% above or below nominal voltage. The motor duty rating shall be sufficient for one complete open to close to open (or reverse) cycle without exceeding its temperature rating. The motor shall be pre-lubricated and all bearings shall be of the anti-friction type.
   3. A handwheel shall be provided for manual operation. The handwheel shall not rotate during motor operation nor shall a fused motor prevent manual operation. When in manual operating position, the unit will remain in this position until motor is energized at which time the valve operator will automatically return to electric operation and shall remain in motor position until handwheel operation is desired. This movement from motor operation to handwheel operation shall be accomplished by a positive declutching knob or lever which will disengage the motor and motor bearing mechanically but not electrically. Hand operation must be reasonably fast and require no more than 100 lbs. of rim effort at a maximum required torque. It shall not be possible for the unit to be simultaneously in manual and motor operation.
   4. Actuator controls shall consist of 460V integrally mounted disconnect, 3 phase solid state reversing starter, 120V control transformer with grounded and fused secondary, adjustable torque overload switches, four position geared limit switches for valve stop control. Provide open/closed position report back limit switches with dry contacts wired to the master terminal strip for tie-in to central control system. Provide the actuator with integrally mounted local/off/remote and open/stop/closed selector switches, open and closed position indicator lights, and terminal strip for field wiring terminations. Provide an auxiliary dry contact on the “remote” position of the selector switch and wire to the master terminal strip. Also, provide field

terminals for remote valve open and closed dry control contacts originating from the treatment plant's central control system. Coordinate actuator wiring requirements with the control and instrumentation system supplier and provide actuator control wiring diagrams tailored to the requirement. The reversing starter shall be rated per IEEE 587, Category B standard to withstand a 6000 volt surge for 50 microseconds.

5. Unless otherwise specified, the valve actuator shall be housed in a NEMA 4 enclosure. Motor actuators shall be integrally mounted on the valve body unless otherwise specified.
6. Motor actuators shall be Rotork, Limitorque, EIM, or AUMA.

SCHEDULE OF MOTOR ACTUATED PLUG VALVES

| QTY. | SERVICE | VALVE SIZE | VALVE TYPE | ACTUATOR TYPE | NOTE |
|---|---|---|---|---|---|
| 2 | Aerobic Digester No. 1 & 2 Sludge Feed | 6" | 2-way | Open-Closed | 1 |
| | | | | | |
| 2 | Aerobic Digester No. 3 & Hauled Sludge Digester No. 2 Sludge Feed | 6" | 2-way | Open-Closed | ___ |
| | | | | | |
| 3 | Aerobic Digester Sludge Draw Off | 6" | 2-way | Open-Closed | ___ |

Note:

7. Motor Actuator mounted on a stainless steel floor stand.

**2.5 GLOBE VALVES**

A. For use on air piping or for throttling service on water lines.
B. Bronze body rising stem, union bonnet, stainless steel plug type seat and disc. 200 psi working pressure.

**2.6 BALL VALVES**

A. Stainless Steel Ball Valves:
   1. Provide ball valves with stainless steel bodies and ball, double seal TFE seat, TFE stem seal and bonnet O-ring where stainless steel ball valves are indicated on the Contract Drawings Ball valves shall have a 200 psi working pressure and flanged or threaded joints as applicable.
B. Ball valves utilized on copper or steel water piping, unless otherwise noted, shall have a bronze body, chrome-plated brass ball, bronze stem, packing gland and nut, and a lever type handle. Seats and seals shall be reinforced TFE. The valve shall have threaded end or solder end connections and a minimum working pressure rating of 200 psi. Ball valves shall be as manufactured by Nibco, Inc., or equal.
C. PVC Ball Valves: True union, double entry; Viton O-ring seals, self-lubricating Teflon seats. 150 psi working pressure. Ball shall be positively retained to prevent blowout if valve union is removed.
D. Motorized PVC Ball Valves
   1. Ball valves shall be electrically actuated True Union type constructed from PVC type I Cell Classification 12454. All O-rings and seats shall be Viton®. All valves shall have double O-ring

stem seals. All valve union nuts shall have Buttress threads. All seal carriers shall be Safe-T-Blocked® . All valve components shall be replaceable. All 1/2” through 2” valves shall be pressure rated at 235 psi for water at 73°Fand 150 psi for valves 2-1/2" through 6" . Electric actuators shall be factory installed, 115 VAC with thermally protected, reversing motor and NEMA 4X rated enclosure. All mounting fasteners shall be Type 316 stainless steel. Actuator shall be equipped with auxiliary open and closed position report back limit switches, position indication, and manual override handwheel.

SCHEDULE OF MOTOR MORTORIZED PVC BALL VALVES

| QTY. | VALVE SIZE | SERVICE |
|---|---|---|
| 2 | 2-1/2" | Centrifuge No. 1 & 2<br>Flushing Water Feed Control |

**2.7 BUTTERFLY VALVES (METAL BODY)**

A. Rubber seated, tight-closing type designed, manufactured and tested in accordance with AWWA C504, latest revision.
B. Valve Body: Cast iron, ASTM A126, Class B.
C. Body Seat: 18-8, 304 or 316 stainless steel if a resilient seat ring is provided in the valve vane. Body seat shall be Buna-N or EPDM if a stainless steel seat ring is provided in the valve vane.
D. Valve Seats: Elastomer seat recess mounted, bonded, or mechanically secured to the valve body or disc. When the seats are on the disc, secure seat to the disc with a serrated 18-8 stainless steel clamping ring. When the seat is on the body, furnish the disc with a stainless steel seating edge.
E. Valve Vane: Ductile iron, A536, Grade 65-45-12.
F. Valve Shafts: 18-8 Type 304 stainless steel with diameter equal or greater than as shown in AWWA C504.
G. 200 psi working pressure. Valves used on blower discharge piping shall have a 350 degree F working temperature rating.
H. Furnish with valve position indicator.
I. Notch-plate lever throttling handles for valves 6" size and smaller.
J. Heavy-duty manual actuators for valves larger than 6" size.
    1. Sealed and permanently lubricated. Fully supported, exert no thrust or load on valve shaft.
    2. Vertical, right-angle or buried type as applicable. Crank handle, handwheel, or square nut operator as indicated on the Drawings.

**2.8 CURB STOPS**

A. Brass body and solid bronze tee head, conforming to AWWA C800 (ASTM B62 and ASTM B584). Compression type union inlet and outlet. Double Buna-N O rings in stem, spherical ball, molded Buna-N rubber seats. Size as indicated on the Contract Drawings.

**2.9 CORPORATION STOPS**

A. Brass or red-brass alloy body, ASTM B62. AWWA C800 threaded inlet end for tapping. Outlet end suitable for service pipe intended.

**2.10 TELESCOPIC VALVE**

A. Telescopic valve assembly consisting of a cast iron floor flange with an elastomeric O-ring seal, a PVC pipe slip tube, stainless steel bail, and a non-rising stem lifting mechanism. The slip tube shall not contain "V" notches.
B. Lifting Mechanism:
   1. Offset type stainless steel floor stand, secured to concrete construction with stainless steel anchor or expansion bolts. Position indicator graduated to show position of slip tube.
   2. Non-rising stainless steel threaded stem, anti-friction drive sleeve, handwheel operator. Bottom end of stem provided with acme threads engaging a bronze nut fixed to the slip tube bail. Provide means to prevent the slip tube from rotating with the stem. Valves to be manufactured by Fontaine, or equal.

**2.11 FLOOR TYPE TANK PRESSURE RELIEF VALVES**

A. Floor type hydrostatic pressure relief valve shall be 6" diameter, designed for installing in the bottom of concrete tanks.
B. The assembly shall consist of three parts: cover, body and strainer; all of cast iron conforming to ASTM A126, Class B, designed so that neither the cover or strainer can become separated from the body of the valve, due to groundwater pressure around the tank; however, when necessary, both may be easily removed by turning them to the right or left to free them from locking lugs cast integrally on the inside of the body.
C. The seats shall be of Buna N installed into grooves on underside of cover and top of body.
D. Floor type pressure relief valves shall be as manufactured by Trumbull Industries of Youngstown, Ohio, or equal.

**2.12 SOLENOID VALVES**

A. Two-way type. Forged brass body, Buna N seat, 150 psi working pressure. 0 psi operating differential. NEMA IV enclosure, 120 volt, continuous duty coil. Normally closed, energize-to-open. Solenoid valves shall be ASCO, or equal.

**2.13 PRESSURE REDUCING/REGULATOR VALVES (AIR AND LIQUID)**

A. Maintain constant downstream pressure regardless of varying upstream pressures.
B. Bronze body, renewable nickel-alloy seat, removable stainless steel strainer, replaceable bronze diaphragm, stainless steel adjustment spring.
   1. 250 psi working pressure

**2.14 YARD HYDRANTS**

A. Self-draining, frost-proof with 1-1/2" diameter FMNPT inlet connections, 1-1/2" hose connection and a 4 feet depth of bury. The hydrant base, stock, and top shall be fabricated from heavy, one-piece iron castings. The inner supply line assembly shall incorporate 85-5-5-5 heavy duty solid red brass castings conforming to ASTM B61 and B62. The hydrant nozzle shall be a solid brass casting. The hydrant shall have a one-piece iron casting handwheel. The hydrant internals shall be field replaceable by removal through the top of the hydrant barrel. Hydrant shall be coated with a high grade oil base paint. Hydrant shall be a Model 150 anti-freezing, compression-type post hydrant as manufactured by Murdock, Inc., Cincinnati, OH (Phone No. 513-471-7700), by John C. Kupferle, or equal.

**2.15 HOSE BIBBS**

A. Cast brass with replaceable valve set, stainless steel shaft, nylon washer. 3/4 inch HPT or 1-1/2 inch outlet as indicated on the Contract Drawings. Fixed operating wheel for outdoor service. Provide frost free type for outdoor service. Provide hose bibbs with stainless steel bodies when indicated on the Contract Drawings.

**2.16 HOSE VALVES**

A. Stainless steel body with replaceable valve seat stainless steel shaft, handwheel and 1-1/2 inch hose pipe thread outlet.

**2.17 VALVE BOXES**

A. Three-piece, cast iron, adjustable. 5-1/4 inch diameter. Heights as indicated.

**2.18 PRESSURE GAUGES (LIQUID SERVICE)**

A. Bronze bourdon tube type, glycerin filled, brass socket. Phenolic or cast aluminum case. Acrylic window.
B. 4-1/2 inch dial size. Stainless steel dial, black lines and numbers.
C. Pressure range as indicated. Graduations and figure intervals proportioned to range.
D. Polypropylene bushed, stainless steel rotary movement, micro-adjustable pointer. Minimum pressure stop, over-pressure protection. Adjustable zero set point adjustment screw which does not require removal of gauge case.
E. Accuracy to 1 percent of full-scale range.
F. 1/2 inch NPT bottom connection. Shutoff cock.
G. Gages mounted on sewage pump piping shall be provided with cadmium-plated diaphragm gauge seal; 316 ELC diaphragm, flushing connection, stopcock.

**2.19 PRESSURE GAUGES (AIR SERVICE)**

A. Bronze bourdon tube type, glycerin filled, brass socket. Cast aluminum case with blowout grommet.
B. 4-1/2 inch dial, white background, black lines and numbers.
C. Bronze bushed, rotary movement. Micro-adjustable pointer. Accuracy to 1 percent of full-scale range.
D. 1/4 inch bottom connection. Shutoff cock.
E. Pressure range as indicated shall cover 150% of operating range. Graduations and figure intervals proportioned to range.

**2.20 HOSE COUPLINGS**

A. Cam-locking quick-coupler. MPT coupler socket, FPT adapter plug, side levers. Stainless steel. Buna N gaskets. Meet MIL-C-27487 Specifications.

**2.21 FLEXIBLE COUPLINGS AND REDUCERS**

A. Flexible couplings and reducers are to be provided where shown on the Drawings to compensate for misalignment, reduce noise and vibration, and alleviate stresses imparted to mating equipment.
B. Unless otherwise noted, couplings shall be of the double arch type capable of allowing up to 2.50 degrees angular movement, 3/8 inch elongation, 3/4 inch compression, and 1/2 inch transverse movement. The couplings shall have a 26 inch Hg vacuum and a 150 psi pressure rating. The couplings shall be constructed of neoprene with multiple plies of nylon cord. Couplings shall have 150 lb. ANSI steel flanges that do not require the use of backup rings. Provide control units for each coupling and

reducer to prevent damage due to excessive movement.

C. For flexible couplings used on chemical piping applications, submit manufacturer's certification that the materials of construction of the coupling are suitable for continuous exposure to the chemical being transported.

**2.22 INLINE STATIC MIXERS**

A. Install in polymer feed pump discharge piping to facilitate mixing of dilution water and polymer.

B. Motionless type, achieving mixing by a fixed arrangement of baffles within a tube to create shearing and radial forces. Mixers which achieve mixing by creating high turbulence are not acceptable. Minimum six elements, 19" maximum length.

C. Maximum Viscosity of Polymer Solutions: 400 cps.

D. Clear Schedule 40 PVC pipe body, threaded ends, minimum 150 psi working pressure rating.

E. Static mixer shall be Koflo Series 308 or equal.

F. Static mixer design shall conform to the following:

| Quantity | Service | Water Flow Rate (GPM) | 3/4% Polymer Solution Flow Rate (GPM) | Max. Pressure Drop |
|---|---|---|---|---|
| 2 | Centrifuge Polymer Feed System | Min. 1.0<br>Max 24 | Min. 1.0<br>Max. 12.0 | 3.5 psi |

Maximum water flow and maximum polymer flow will occur simultaneously.

**2.23 DILUTION WATER FLOW INDICATORS**

A. Flow shall enter the bottom of the indicator. The flow as it travels upward through the unit shall raise a float within a graduated glass metering tube. The height the float is raised shall be proportional to the flow rate through the tube.

B. The flow indicator shall have a borosilicate glass metering tube graduated in gpm; a stainless steel float and float stops; CPVC end fittings, with acrylic plastic tube housing; Vitron O-rings; and NPT process connections. Connection size as indicated on the Contract Drawings or as required to provide the flow range indicated on the Contract Drawings within the maximum allowable headloss specified. The flow meter shall have 130 psi minimum working pressure rating, shall have a plus/minus 10% of full-scale accuracy, and a repeatability of plus/minus 1% of full-scale. Maximum allowable pressure drop through the flow meter at full-scale flow rate shall be 0.25 psi. The glass metering tube shall be removable without disassembling the flow indicator. Full scale flow rate shall be as indicated on the Contract Drawings.

**2.24 HYDRA-STOP FITTING AND ACCESSORIES (TEMPORARY LINE STOP VALVE)**

A. Fitting shall be full encirclement type, split tee. It shall consist of two halves: (1) An upper Hydra-Stop flange saddle half. The interior of the saddle plate adjacent to and concentric with the O.D. of the nozzle shall have a full encirclement gasket which shall seal the saddle plate to the exterior of the main. This gasket shall constitute the only seal between the main and the fitting. (2) A lower bottom solid

half with bolting arrangement for fastening to upper half.

1. Hydra-Stop Flange: The outlet of each fitting shall be machined from a 150 lb. forged steel flange (ASTM A181 or A105) or from pressure vessel quality steel plate (ASTM A285, Grade C); flat faced and drilled per ANSI B16.5. Suitable independently operated locking devices shall be provided in the periphery of the flange to secure the completion plug.
2. Hydra-Stop Nozzle: The nozzle, which lies between the saddle and the flange, shall be fabricated from steel pipe (ASTM A234).
3. Completion Plug: The completion plug shall be machined from a stress relieved carbon steel weldment. It shall contain two (2) circumferential grooves: one to receive the locking devices from the Hydra-Stop flange, and the second to contain a compressible "O" ring to seal pressure tight against the bore of the flange.
4. Blind Flange: Each Hydra-Stop fitting shall be closed with a blind flange. Facing and drilling of the blind flange shall be compatible with that of the Hydra-Stop flange. Minimum blind flange thickness shall be that of AWWA Spec. 207, Class D.
5. Saddle Alignment Marking: Each saddle half shall be matched and marked with serial numbers, to insure proper alignment in the field.
6. Fasteners: All bolts, studs, and nuts used on Hydra-Stop and drain/equalization fittings shall be of the heavy series.
7. General: Manufacturer will exercise extreme care to insure that weldments are of adequate strength, properly shaped, securely reinforced, and free from distortion that could stress the main during installation, pressure tapping, or Hydra-Stopping operations. All steel shall meet the requirements of ASTM A36, as a minimum. All weldments shall be braced and stress relieved.
8. Gaskets: Shall be molded from elastomer compounds that resist compression setting and are compatible with water in the 32 to 140 degree F temperature range.
9. Upper Hydra-Stop Flange Saddle: Shall consist of a saddle plate, a Hydra-Stop flange, and a Hydra-Stop nozzle.
    a. Saddle plate shall be of a minimum of .375" in thickness. It shall be shaped to be concentric to the outside of the Asbestos-Cement main.
    b. A Hydra-Stop nozzle of .375" min. wall thickness shall be securely welded to the saddle plate.
    c. The Hydra-Stop flange shall be securely welded to the nozzle. After welding, the assembly shall be braced, stress relieved, and bored to receive the completion plug.
    d. Bolt, nut and washer assemblies shall be furnished to draw the upper and lower saddles together for sealing. Bolting brackets shall be gusseted.
10. Lower Saddle Plate: Saddle plate shall be of a minimum .375" thickness and shall be shaped to be concentric to the outside of the main. Gusseted bolting brackets shall match upper half.
11. Coating: After fitting has been stress relieved and machined, the exterior and unmachined interior surfaces shall be sandblasted and coated with coal tar epoxy to a final minimum cured thickness of .020".

**2.25 SCUM SPRAY NOZZLES**

A. Spray nozzle shall be of Delrin construction with 1/2” NPT connection and 3/8” bore. Spray nozzle shall have a hinged spring loaded cap that is raised to flush the nozzle clean and creates a flat spray when fully lowered. The nozzle shall create a 60” wide spray pattern at an 18” distance from its tip with a 2

GM flow rate at 2.7 PSI. Spray nozzle shall be USA Blue Book Item No. 4812.

**2.26 FLOOR BOX**

A. Bushing type floor box, fitted with bronze bushings to pressure stem alignment. Non-rising type stem with cover. Location and size as indicated on the Contract Drawings.

**2.27 STEM GUIDES**

A. Stem guides shall be 304 stainless steel and bronze bushed. Center of stem to face of wall shall be as shown on the Contract Drawings. Stem guides shall be utilized for the support of extension stems greater than 6' long and shall be spaced 5'. Fasten stem guides to wall with stainless steel expansion bolts.

**2.28 EXTENSION STEMS**

A. Extension stems shall be provided for operation of valves where required. Stems shall be made from extra heavy stainless steel pipe or stainless steel rod. Extension stems shall be complete with coupling for attachment to valve stem for non-rising stem valves and stem coupling for OS&Y gate valves. Where extension stems will be used in conjunction with floor stands, stems will be provided with a coupling for connection to the floor stand. Where required, universal joints shall be provided for deflection. Extension stems shall be sized so as to transmit full torque from the operating mechanism to the valve stem without binding, twisting, or bending.

**2.29 CHAINWHEELS**

A. Where valves are installed more than 6'-0" above finished floor elevation, provide chainwheels of a Babbitt type which will bolt to existing handwheel. Rust proof chain to ASTM A153-71. Chainwheels shall be of the adjustable sprocket type which allow free fall of the chain with no binding.
B. Where required, for overhead installation, chainwheels will be provided of a Babbitt type which will bolt to existing handwheel. Rust proof chain to ASTM A153-71. Chainwheels shall be of the adjustable sprocket type which allow free fall of the chain with no binding.

**2.30 PIPE SADDLES**

A. Double strap type, designed to hold pressures in excess of the working pressure of the pipe.
B. ASTM A536 ductile iron body with integrally cast tapered gasket cavity, ASTM A307 carbon steel wrap around straps, cold formed semi-finished heavy hex head steel nuts and carbon steel washers, and gasket resilient to process fluid. Straps, nuts, and washers to be electrogalvanized with dichromate seal. Saddles utilized on PVC pipe shall be specifically designed for that application.

**2.31 PVC HOSE**

A. Hose shall be corrugated with smooth wall interior having a 15 ft. minimum vacuum rating and a 30 psi pressure rating. Fasten with stainless steel clamps.

**2.32 KNIFE GATES**

A. A36 carbon steel or cast iron wafer style body, 304 stainless steel gate, single pitch stainless steel stem, bronze stem bushings, heavy-duty steel or cast iron yoke, replaceable seat ring, and packing. Full port design, 150 psi working pressure, bubble tight shutoff with pressure on either side of gate up to design working pressure, ANSI 150 lb. flange drilling, with all flange holes tapped. Provide with manual gear

operator. Provide valve with motor actuator connected to input shaft of the valve gear actuator. Motor actuators shall be as specified for the plug valves. Actuator must be arranged to clear building walls.

**SCHEDULE OF MOTOR ACTUATED KNIFE GATE VALVES**

| Quantity | Service | Valve Size | Actuator Type |
|---|---|---|---|
| 2 | Digester No. 1 and No. 2 Sludge Draw Off | 6" | Open/Close |

**2.33 PRESSURE RELIEF VALVES FOR HYDROPNEUMATIC TANKS**

A. Install one relief valve on outlet of each pressurizing tank, on the tank side of valves and controls.
B. Diaphragm guided, positive shutoff, automatic re-seating, full flow discharge, built-in vacuum relief, manual test lever.
C. Brass body, die cast aluminum top cover; nordel diaphragm; silicone poppet disc; stainless steel spring.
D. Capacity: 50 gpm at 105 psig; relief setting.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Install valves and accessories in accordance with the manufacturer's instructions.
B. Inspect joint surfaces for structural soundness and thoroughly clean before installation.

**3.2 ADJUSTMENT**

A. Check and adjust valves and accessories for smooth operation. Adjust valve position report back and torque overload limit switches, where applicable. Check motorized valve amp draws.

**END OF SECTION 40 23 00**

**SECTION 40 23 21**
**TESTING PIPING SYSTEMS**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of This Section Includes, but is not limited to:
   1. Gravity Pipe Low-Pressure Air Testing
   2. Pressure Pipe Hydrostatic Testing

B. Related Work Specified Elsewhere:
   1. Section 31 23 17 - Trenching, Backfilling and Compacting
   2. Section 40 23 19 - Pipe and Pipe Fittings
   3. Section 40 23 20 - Valves and Piping Specialties

### 1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. American Society for Testing and Materials (ASTM):
      a. ASTM F1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
   2. American National Standards Institute (ANSI); American Water Works Association (AWWA):
      a. ANSI/AWWA C600 - Section 4 - Hydrostatic Testing

B. Test Acceptance:
   1. No test will be accepted until leakage rate is below specified maximum limits.
   2. The Contractor shall determine and correct the cause of test failures and retest until successful test results are achieved.

### 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Submit the following prior to start of testing:
   1. Test Procedures
   2. List of Test Equipment
   3. Testing Sequence Schedule
   4. Certification of test pressure gauge calibration and accuracy

## PART 2 PRODUCTS

### 2.1 AIR TESTING EQUIPMENT

A. Air Compressor
B. Air Supply Lines
C. Test Connections
D. Pressure Regulator
E. Pressure Relief Valve
F. Pressure Gauge Calibrated to 0.1 pounds per square inch

### 2.2 HYDROSTATIC TEST EQUIPMENT

A. Hydro Pump
B. Pressure Hose
C. Test Connections
D. Pressure Relief Valve
E. Pressure Gauge Calibrated to 0.1 pounds per square inch

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Backfill trenches in accordance with Section 31 23 17.
B. Provide concrete reaction support blocking, cured a minimum of seven days, or a minimum of three days if high early strength concrete is used, for the pipeline to be tested.
C. Flush pipeline to remove debris; collect and dispose of flushing water and debris in a manner conforming to Regulatory Agency requirements.

### 3.2 AIR TESTING GRAVITY FLOW PIPELINES

A. Test each section of gravity flow pipeline between structures; plug all pipeline outlets; brace plugs to offset thrust.
B. Slowly introduce air to the plugged pipeline until internal air pressure is approximately 4 psig.
C. If groundwater is present, determine its elevation above the springline of the pipe by means of a piezometric tube; for every foot of groundwater above the springline of the pipe, increase the starting test pressure reading by 0.43 psig; do not increase pressure above 9 psig.
D. Allow air pressure to stabilize for at least five minutes; adjust pressure to 3.5 psig or to the increased test pressure as determined above if groundwater is present; start the test.

E. Determine the test duration for a section with a single pipe size from the following table.

| Pipe Dia.in. | Min. Time min:s | Length for Min. Time, ft. | Time for Longer Length, s | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 3:46 | 597 | 0.380 L | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 | 3:46 |
| 6 | 5:40 | 398 | 0.854 L | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 |
| 8 | 7:34 | 398 | 1.520 L | 7:34 | 7:34 | 7:34 | 7:34 | 7:36 | 8:52 | 10:08 |
| 10 | 9:26 | 239 | 2.374 L | 9:26 | 9:26 | 9:26 | 9:53 | 11:52 | 13:51 | 15:49 |
| 12 | 11:20 | 199 | 3.418 L | 11:20 | 11:20 | 11:24 | 14:15 | 17:05 | 19:56 | 22:47 |
| 15 | 14:10 | 159 | 5.342 L | 14:10 | 14:10 | 17:48 | 22:15 | 26:42 | 31:09 | 35:36 |
| 18 | 17:00 | 133 | 7.692 L | 17:00 | 19:13 | 25:38 | 32:03 | 38:27 | 44:52 | 51:16 |
| 21 | 19:50 | 114 | 10.479 L | 19:50 | 26:10 | 34:54 | 43:37 | 52:21 | 61:00 | 69:48 |
| 24 | 22:40 | 99 | 13.674 L | 22:47 | 34:11 | 45:34 | 56:58 | 68:22 | 79:46 | 91:10 |
| 27 | 25:30 | 88 | 17.306 L | 28:51 | 43:16 | 57:41 | 72:07 | 86:32 | 100:57 | 115:22 |
| 30 | 28:20 | 80 | 21.366 L | 35:37 | 53:25 | 71:13 | 89:02 | 106:50 | 124:38 | 142:26 |
| 33 | 31:10 | 72 | 25.852 L | 43:05 | 64:38 | 86:10 | 107:43 | 129:16 | 150:43 | 172:21 |
| 36 | 34:00 | 66 | 30.768 L | 51:17 | 76:55 | 102:34 | 128:12 | 153:50 | 179:29 | 205:07 |

F. Record the drop in pressure during the test period; if the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed; if the 1 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.

G. If the line fails, determine the source of the air leakage, make corrections and retest. After the leaks are repaired, retest the entire section.

H. The Contractor has the option to test the section in incremental stages until the leaks are isolated.

I. Testing Pipe Over 36 Inch Diameter:

1. Pipe larger than 36 inch diameter shall be subjected to a visual interior inspection.

**3.3 HYDROSTATIC LEAKAGE TESTING PRESSURE FLOW PIPELINES**

A. Applicable to pressure flow yard piping.

B. Hydrostatically test each section of pressure pipeline at the pressure designated on yard piping plan, based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge, for a minimum period of one hour.

C. Slowly fill the section with water, expelling air from pipeline at the high points; install corporation cocks at high points if necessary; after all air is expelled, close air vents and corporation cocks and raise the pressure to the 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. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine leakage rate.
F. Maintain pressure within plus or minus 0.5 psig of test pressure.
G. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test and shall not exceed that determined by the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

Where:

L is the allowable leakage in gallons/hour
N is the number of joints in the section tested
D is the nominal diameter of the pipe in inches
P is the average test pressure in psig

If line under test contains sections of various diameters, the allowable leakage shall be the sum of the computed leakage for each size.

H. If the test of the pipeline indicates leakage greater than that allowed, locate the source of the leakage, make corrections and retest until leakage is within the allowable limits.
I. Correct visible leaks regardless of the amount of leakage.

**3.4 HYDROSTATIC TESTING PRESSURE PIPING SYSTEMS**

A. Fill entire systems with water and vent air from the system at least 24 hours before the actual test pressure is applied.
B. Apply the required test pressure when the water and average ambient temperatures are approximately equal and constant.
C. Test piping at pressures listed on Yard Piping Plan; avoid excessive pressure on safety devices and mechanical seals.
D. Maintain test pressure for a minimum of two hours without drop after the force pump has been disconnected.
E. Visually inspect joints, fittings, and valves while pipe is under test pressure.
F. Correct all visible leaks and retest as often as necessary until satisfactory results are achieved.

**END OF SECTION 40 23 21**

**SECTION 40 90 00**
**PRIMARY PROCESS MEASURING DEVICES**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes
   1. Analyzers, cables, and associated equipment for measuring orthophosphate in water and wastewater treatment systems. Transmitters and modules required for a complete monitoring system are specified elsewhere.

B. Scope
   1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation analyzers as shown on the Drawings and specified herein.
   2. The Drawings and Specifications illustrate and specify functional and general construction requirements of analyzers and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination: Coordinate with other suppliers for installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

### 1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

### 1.3 SUBMITTALS

A. Product data
   1. Analyzer operating manual.
   2. Mounting bracket installation instructions.

B. Manufacturer's Certifications: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

C. Warranty documentation: Submit manufacturer's standard warranties.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, all materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.

### 2.2 ORTHOPHOSPHATE (PO4-P) ANALYZER (50OPA-100)

A. Overview:
   1. Measurement principle shall be colorimetry by means of the vanadomolybdate method (yellow method).
   2. Orthophosphate measurement system shall be intended for use as a stand-alone instrument or as part of a multi-parameter monitoring network.

3. Orthophosphate measurement system components shall be designed to be part of an analytical process control system with enhanced protection from overvoltage due to lightning and power supply fluctuations when installed using manufacturer's recommended components per manufacturer's instructions.
4. An on-line nutrient analysis system for detection of orthophosphate and percent transmittance shall be furnished in strict accordance with these specifications.
5. The orthophosphate analyzer shall be located within the vicinity of the proposed Denitrification Filter's Clearwell. Its purpose will be to sample, analyze and maintain a targeted total phosphorus (TP) of 1.0 mg/L.
6. The chemical to control the TP will be aluminum sulfate (alum).
7. There will be two (2) alum injection points each with a dedicated pump. One injection point will be located at the sequential batch reactor's (SBR) influent pre-anoxic tank. The second injection point will be located at the proposed Denitrification Filter's effluent pump station. Both pumps shall have the capability to be operated in either AUTO or MANUAL.
8. A 4-20 mA signal shall be sent from the orthophosphate analyzer (50OPA-100) via the terminal transmitter 50AIT-100 to the Filter Building's PLC-IP to control whichever alum feed pump is in AUTO mode. Only one (1) pump will be allowed to be operated in AUTO mode. The terminal transmitter will be located by the SBR influent pump station. The Filter Building's PLC-IP will be located at the Filter Building's Electric Room.

B. Product and Manufacturer:
   1. YSI Incorporated's Orthophosphate Analyzer with twin-cabin for external installation.
   2. Or Approved Equal
C. Power supply (stand-alone): 115V AC / 60 Hz
D. Technical
   1. Measurement Range: 0.05 to 15.0 mg/L PO4-P
   2. Resolution: 0.01 mg/L PO4-P
   3. Accuracy: +/- 0.5 mg/L PO4-P
   4. Response Time: < 5.0 minutes
   5. Detection Limit: 0.05 mg/L PO4-P
   6. Calibration: Automatic (adjustable) or manual
   7. Measuring Interval: 10 minutes or greater
   8. Climate Control: Heating, Cooling (fan)
   9. Operating Temperature: -4 to 104 F
   10. ph Range: 5 to 9 pH units
E. Photometer Unit:
   1. Power supply: 15V DC
   2. Transmitter
   3. Status LED
   4. Optics
      a. 400 nm LED
      b. Photo diodes
   5. Power supply / communication interface
   6. Overflow vessel: Multi-port mixing valve block with inlet and outlet tubing.

7. Pump: Syringe type

F. Filtration Pump:
1. Control panel with pump frequency indicator
2. Return line, heat-traced tubing
3. Manometer

G. Filter membrane module
1. Chain
2. Guiderail
3. Adjustable slide
4. Suction line, heat-traced tubing
5. Sleeve tube
6. Filter membrane insert

H. SNCIQ network connection cable.
1. Capable of transmitting digital communications and low voltage (24V) power.
2. Integrated shield.

I. Materials
1. Enclosure:
a. Structure: Powder-coated aluminum
b. Door seals: NBR
c. Screws: 304 Stainless Steel
2. Photometer Unit
a. Overflow vessel: PVC
b. Pump
1) 1.6 mm ID Norprene tubing

J. Filter membrane module
1. Frame: PVC
2. Filter media: PVDF with polyester fleece on both sides
a. PVDF with 0.45 micron pore openings
b. Polyester fleece on both sides
c. Surface area: 1,000 cm2 (155 in.2)
3. Suction tubing: polyethylene
4. Sleeve tube: PVC-reinforced PCV tube

K. Network connection cable
1. Conductors: Tin-coated stranded copper wire.
2. Cable sheath: PUR
3. Protective cap: PVC
4. Protection rating: IP68 (waterproof)
5. Warranty: 12 months

L. Accessories:
1. Rail mount assembly: (To be mounted on the platform's guide rails that accesses the Clearwell Tank) :
a. YSI model 821 988Y
b. Or Approved Equal

2. Chemicals
    a. Standard solution: 0.0 mg/L PO4-P Alyza
    b. Standard solution: 1.0 mg/L PO4-P Alyza
    c. Cleaning solution: Alyza
    d. Cleaning set for measuring range 1 PO4 (0.02 - 15.0 mg/L PO4) consisting of reagent 1A, 1B for analyzer Alyza IQ

M. Schedule

| Description | Number | Tagging | Enclosure |
|---|---|---|---|
| Orthophosphate Analyzer | 1 | 50OPA-100 | NEMA 3S |

**2.3 RADAR LEVEL SENSOR (50LE-120)**

A. Manufacturers
1. Vega
2. Or Approved Equal

B. General
1. The non-contact radar sensor for shall be designed for continuous level measurement. The transmitter electronics shall be based on Pulse Burst Radar technology emitting short bursts of 26 GHz energy, measuring the empty space above the liquid level and convert these variations into a linear 4-20mAdc signal. The signal processing shall filter out false reflections and other background noises and it shall be immune from changes in dielectric, specific gravity, and vapors.
2. Calibration, with the need to move the process liquid, shall not be necessary. Bench configuration of all configuration parameters of the unit (less false target rejection), prior to installation, shall be possible. False Target Rejection will be performed effectively without the need for a secondary device (PC, laptop computer, HART Handheld). The transmitter will have the ability to effectively track rapid rates of level change up to 180 inches (450 cm)/minute. The transmitter housing shall be directly coupled to the sensing antenna. The unit shall be capable of rotating and positioning the polarization of the radar signal on the surface level, to optimize performance and facilitate installation and setup, at any point in 180 degrees without removing the instrument from its secured, in-process mounting position.
3. The rotation and positioning of the polarization path shall be accomplished through the use of an internal indexed dial, fully accessible from the top of the unit. Units not allowing for rotation and positioning of the polarization path through an internal indexed dial shall not be acceptable.

C. Construction Features
1. The sensor shall consist of a microprocessor-based electronic Radar transmitter (26 GHz) housed in a rugged, watertight, dust-tight, submersible, corrosion resistant (NEMA 4X, 6 and IP67) enclosure.
2. The antenna shall be a fully encapsulated horn style; all wetted surfaces will be Polypropylene or Tefzel and be rated from vacuum to 200 psig (-1 to 13.8 bar) and -40 to +200F (-40 to 93oC).
3. The antenna will be a radome design and shall utilize a dielectric window to maximize performance. Units without the radome/dielectric window functionality will not be acceptable.
4. The connection size for the unit shall be 2-inch NPT

D. Performance Specifications

1. The transmitter shall operate as a two wire, 4-20mA device from 16 to 36VDC. The 4-20mA output shall operate from 3.8mA to 20.5 mA (per Namur NE43) and have diagnostic fault values of 3.6mA, 22mA and HOLD last value.
2. The minimum blocking distance shall be 15 inch (380mm) as measured from bottom of the process connection threads. The unit shall have the ability to be mounted to reduce the unusable area near the tank top to 3 inches (80mm) or less.
3. The maximum measuring range shall be 40 feet (12.2m). The transmitter will be approved for FM and CSA General Purpose, Intrinsically Safe (CL 1, Div 1) and Non-incendive (CL I, Div 2).
4. The sensing antenna will be supplied with an antenna extension of 8 inch if required.
5. The sensor shall transmit and receive a radar signal to accurately measure fluid depth at the monitoring site. The level measurement span shall be from 0 to 40 feet (0 to 12.2 m) with following characteristics:
   a. Linearity: ± 0.2 inch or 0.05% of tank height
   b. Measured Error: ± 0.2 inch or 0.05% of tank height
   c. Resolution: 0.1 inch
   d. Repeatability: ± 0.2 inch or 0.05% of tank height
6. The ambient temperature rating shall be from -40F to +175F (-40oC to +80o). The sensor shall not require built-in temperature compensation to automatically compensate for air-temperature changes.
7. The sensor shall have manual gain adjustments to maximize performance in the presence of steam, turbulence and other process variables.
8. The sensor shall have adaptive gain capability that automatically adjusts for changing process conditions in real time.
9. The sensor shall include variable blocking distance to ignore echoes from within a programmable distance from the sensor.

E. Schedule

| Description | Number | Tagging | Height Range (feet) | Enclosure |
|---|---|---|---|---|
| Alum Storage Tank's Level Element | 1 | 50LE-120 | 0 – 10 | NEMA 4X |

**2.4 RADAR LEVEL TRANSMITTER (50LIT-120)**

A. Manufacturers
   1. Vegadis
   2. Or Approved Equal

B. General
   1. Provide a transmitter and display for the non-contact radar sensor. The transmitter electronics shall be suitable for Pulse Burst Radar technology.

C. Performance Requirements
   1. Measuring range loop current: 3.5 - 22.5 mA
   2. Deviation: +/- 0.1% of 20mA
   3. Temperature coefficient: +/- 0.1% of span
   4. Display element: Dot matrix with backlight
   5. Number of digits: 5

6. Size of digits: W x H = 7 x 13 mm

D. Characteristics
1. Protection rating
2. Plastic enclosure: NEMA 4X, IP 66/IP67
3. Stainless Steel enclosures: NEMA 6P submersible, IP 66/IP 68 (0.2 bar)
4. Removable backlit display and adjustment module
5. Integral filter element for ventilation
6. Independent modes for 4-20mA and HART
7. Indicating device in HART multidrop system
8. Signal dampening from 0 to 999 seconds
9. Diagnostics for device status, curve indication and echo curve memory

E. Schedule

| Description | Number | Tagging | Enclosure |
|---|---|---|---|
| Alum Storage Tank's Level Indicator Transmitter | 1 | 50LIT-120 | NEMA 4X, Non-integral |

**2.5 LEAK DETECTOR**

A. Provide a optic leak switch to detect any chemical spills within the alum storage's double wall compartment. The switch shall have a SPST relay, and housed in a NEMA 4X rated enclosure suitable for submergence.

B. The sensor and cable jack materials shall be made of PFA.

C. Acceptable Manufacturers:
1. Flowline - Switch-Tek Model LO10-2305-50
2. Or approved equal

D. Schedule:

| Description | Number | Tagging | Enclosure |
|---|---|---|---|
| Alum Storage Tank's Leak Detector | 1 | 50LKS-121 | NEMA 4X |

**2.6 FLOAT SWITCH**

A. Provide a float switch to detect high liquid levels on the alum storage tank. The float switche shall be a hermetically sealed, axially non-position sensitive type, non-mercury-switch activated and enclosed in a polypropylene housing.

B. The switch shall operate over a narrow switching angle and have a minimum rating of 2 Amp at 120 VAC. A 20-ft PVC jacketed power cable, weight, grip cord, and stainless steel mounting bracket shall be furnished as part of the switch assembly. The level switching circuit shall be rated intrinsically safe by inclusion of a UL approved switch isolator with relay output.

C. Schedule:

| Description | Number | Tagging | Enclosure |
|---|---|---|---|
| Alum Storage Tank's High Level Switch | 1 | 50LSH-122 | NEMA 4X |

**2.7 TERMINAL/TRANSMITTERS (50AIT-100)**

A. Manufacturer:
1. YSI Incorporated:

a. a. Multi-parameter MIQ/TC 2020 XT-H3 20-channel terminal/transmitter

2. Or Approved Equal.

B. General

1. Design terminal/transmitter system for continuous operation outdoors.
2. Terminal/transmitters shall stack-mount to any input/output module in the network specified in this section by means of a simultaneous mechanical/electrical connection.
3. Terminal/controller system components shall be designed to be part of a network that has the following capabilities and features:
4. Protected from overvoltage due to lightning and power supply fluctuations and covered by manufacturer's warranty when installed using manufacturer's recommended components per manufacturer's instructions.
5. Powered from a centralized power supply.
6. 24VDC loop powered communication.
7. Modular: Additional sensors, up to a total of 20 sensors per transmitter, and process control input/output modules shall have full functionality from any location in the network.
8. Line, tree, star, and multiple star topology.

C. Performance Requirements

1. Operating range
   a. Temperature: -4°F to 131°F (-20°C to 55°C)
   b. Relative humidity: less than or equal to 90% (yearly average)
   c. Altitude: less than or equal to 6,562 ft. (2,000 m) above mean sea level
2. Automatic air pressure compensation.

D. Manufactured Unit

1. The transmitter shall consist of the following:
   a. Display
      1) Black/white, backlit
      2) Resolution: 320 x 420 pixels
      3) Viewable area: 4.49 in. x 3.39 in.
      4) Display of measured values: lists or daily, weekly or monthly xy chart
   b. Function/operation
      1) 3 function keys
      2) 2 confirmation/switching keys
      3) 4-directional navigation key
   c. Datalogger
      1) Total storage: Up to 525,600 measurements in csv format.
      2) User programmable logging interval: 1 minute to 60 minutes.
   d. Multi-function USB-A port
      1) Electronic key
      2) Firmware upgrade
      3) Data transfer
   e. Status light: blue LED
   f. Terminal transmitter shall use a menu-driven operating system.
   g. Each terminal/transmitter shall control 1 to 20 sensors.

h. Terminal/transmitters shall be portable within the network by connecting to any input/output module in the network by means of a simultaneous mechanical/electrical connection.

E. Model MIQ/CR3 input/output module
   1. Module
      a. Inputs
         1) 2 sensor connections
      b. Outputs
         1) 6 4-20 mA outputs
      c. Cable glands: M 16 x 1.5, 4 total, with screw plug
      d. Status lights: yellow LED, red LED
   2. Model MIQ/PS power supply module
      a. Inputs
         1) 3 x sensor connections
         2) 1 x 100 to 240 VAC power
      b. Cable glands: M 16 x 1.5, 4 total, with screw plug
      c. Status lights: yellow LED, red LED
   3. SNCIQ [SNCIQ/UG] network cable.
      a. 3-conductor shielded cable: communications, power, shield
      b. Conductors: Minimum 18 AWG
      c. Power supply: low voltage (24 V)
      d. Length: 10 feet

F. Terminal/Transmitter
   1. Housing material: ASA
   2. Function keys: silicon
   3. EMI/RFI conformance
      a. EN 61326 Class B
      b. FCC Class A
   4. Safety
      a. Certification: CE, cETLus
   5. Interface
      a. Silicon operating keys
      b. LED status light
   6. 3-year warranty

G. Inputs/Outputs Modules
   1. Housing material: polycarbonate, 20% glass filled
   2. EMI/RFI conformance
      a. EN 61326 Class B
      b. FCC Class A
   3. Safety
      a. Certification: CE, cETLus
   4. Protection rating: IP66
   5. 3-year warranty

H. SNCIQ Network Cable
   1. Conductors: copper
   2. Cable sheath: PUR [with PVC coating for /UG]
   3. Protection rating: IP68 (waterproof)
   4. Warranty: 12 months

I. Accessories
   1. YSI's Model BE/R 170 (rail mounting)
   2. Or Approved Equal

J. Schedule

| Description | Number | Tagging | Enclosure |
|---|---|---|---|
| Terminal/Transmitters | 1 | 50AIT-100 | NEMA 4X |

**2.8 SPARE PARTS**

A. Provide all standard recommended spare parts as specified in the manufacturer's instruction manuals for each component in the system.

B. Where sensors are to be replaceable provide a new sensor probes at the end of the contractor warranty period.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Furnish the services of an engineer representative of the manufacturer of the equipment for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative also shall be available for not less than 2 days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period. Install all equipment in accordance with the recommendations of the manufacturer.

**3.2 FIELD TESTS AND INSPECTIONS**

A. Test and calibrate in place the equipment to demonstrate that it meets the accuracy requirements for the full range as specified herein. Provide all labor, equipment, and incidentals required for the tests, including electric power and water required for tests. The Contracting Officer will witness all field tests and conduct all field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest work affected by such deficiencies at the Contractor's expense. Record data from each field test shall be recorded and documented in a formal field test report and submitted to the engineer. Final set-ups and findings shall be documented in the Operation and Maintenance manuals as well.

**3.3 FIELD QUALITY CONTROL**

A. Site Tests
   1. Calibrate and test all instrumentation and provide documentation that the equipment has been certified to the Engineer.
   2. Adjust the receiving devices to read the calibrated output of the initial calibration. Each system must meet the accuracy indicated in the Specifications.

3. Adjust secondary functions, such as alarm actuation during initial calibration and demonstrate proper calibration after the system is placed in service. Seal linkage or range adjustments by colored lacquer in the presence of the Engineer immediately following calibration.
4. Provide a supplier's representative on site during Preliminary and Final Mechanical Performance Testing.
5. Provide field service representative of the distributed logic control equipment manufacturer to verify that instruments have been properly installed, configured, and meet the manufacturer's qualifications for warranty.

B. Final Performance and Acceptance Test

1. Provide the services of a factory trained and field experienced instrumentation engineer to assist the Owner's personnel during the start-up of the plant process. The purpose of this assistance is to support making final adjustments of settings on the instrument systems prior to performing the demonstrations and final operational testing. Notify the Engineer in writing, a minimum of five (5) working days prior to the proposed date for commencing the Final Performance and Acceptance Test.
2. Upon completion of instrument calibration and system verification, test all systems under process conditions. The intent of this test is to demonstrate and certify the operational interaction of the instrument systems. Testing shall include, but not limited to, taking process variables to their limits (simulated or actual process) to verify all alarms, failure interlocks and/or transfers, and operational interlocks.
3. Immediately correct defects and malfunctions with Engineer approved methods and materials, and repeat the test. Upon completion of the final operational testing, submit the test results and a certified report indicating that all required system tests have been completed satisfactorily and the systems meet the functional requirements of their applicable specifications.
4. Following final operational testing, the system shall operate without a system fault for 30 consecutive days to qualify for Final Acceptance. The Final Performance and Acceptance Tests shall be witnessed, documented and signed off upon satisfactory completion by the Engineer.

**3.4 TIME PERIODS**

A. The following time periods are required for each named type of instrumentation:

| DESCRIPTION | SITE TEST (MAN-DAYS) | FINAL PERFORMANCE & ACCEPTANCE TEST (MAN-DAYS) | TRAINING (MAN-DAYS) |
|---|---|---|---|
| ORTHO-PHOSPHATE ANALYZER | 0.5 | 0.5 | 0.5 |
| RADAR LEVEL SYSTEM | 0.5 | 0.5 | 0.5 |

**END OF SECTION 40 90 00**

**SECTION 40 91 23**
**15 INCH PALMER-BOWLUS FLUME**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. Composition of the Palmer-Bowlus Flume laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for "Hand Lay-UP Laminates," and shall meet the specifications for Type I, Grade 10 laminates shown in Appendix M-1 of said report.

### 1.2 SUBMITTALS

A. Submit design drawings signed and sealed by a professional engineer registered in the State of Maryland.

### 1.3 QUALITY ASSURANCE

A. Manufacturer shall be experienced in the design and manufacture of specific Palmer-Bowlus Flumes and accessories for a minimum period of 20 years.

### 1.4 WARRANTY

A. Manufacturer must provide warranty for 25 years against corrosion.

## PART 2 PRODUCTS

### 2.1 CONSTRUCTION

A. Flume
   1. Palmer-Bowlus Flume with approach shall have a throat size of 15 inches.
   2. Flume body shall be totally manufactured of fiberglass reinforced polyester.
   3. The thickness of the walls and flow of the flume shall be not less than ¼ inch thick.
   4. Flume shall have UV stabilizing pigment in the resin to provide long-term protection from UV.
   5. Flume inside surface shall be smooth, isophthalic gelcoat of 10-20 mil thickness.
   6. The surface shall be free of exposed reinforcing fibers.
   7. The minimum glass content shall be 30 percent exclusive of gelcoat surfaces.
   8. Flume shall be structurally designed to maintain dimensional integrity with a full head of water while being free standing.
   9. Flume shall have a molded-in head gage graduated in 100ths of a foot and centimeters.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Thoroughly clean and remove all shipping materials prior to setting.
C. Install products in accordance with plans, general comments below, and the manufacturer's recommendations.

D. Care shall be taken in the handling, storage, and placement of the flume in preparation for installation. The top spreaders shall be left on the flume until after installation if complete. They may be removed after the grout has cured, if desired.
E. The flume shall be installed level end-to-end and side-to-side and must remain level throughout installation. Flume assembly should be set into a pre-poured block-out/channel.
F. The concrete manhole manufacturer shall provide sufficient shoring and bracing of the flow and sidewalls to prevent lifting, floating, buckling or bulging of the sides and bottom during installation. The side locking clips are not intended to be used as anchorage points. Their function is the key the flume into the grout or concrete.
G. Concrete shall be poured in successive lifts of not more than 6 to 8 inches per lift. Extra care shall be exercised during the first pour to insure that grout flows smoothly under the flow and an even fill is achieved. The first lift shall be allowed to set so that excessive hydraulic forces are not transferred to the bottom of the flume by later lifts.

**3.2 ADJUSTMENT AND START UP**

A. Check flume for being level in both directions, meeting dimensional requirements, and cleaned per manufacturer's instructions.
B. Start-up/calibration of meter in accordance with manufacturer's recommendations.
C. Site to be left clean and free of any debris.
D. Representative shall completed a Certification of Proper Installation and provide copies to the Owner, Engineer, Contractor, and Manufacturing Facility.

**END OF SECTION 40 91 23**

**SECTION 43 32 69**
**CHEMICAL INJECTORS**

## PART 1 GENERAL

### 1.1 SUMMARY

A. Description:
   1. This section includes general requirements for materials and installation of chemical injectors at all locations where chemical solutions are injected into a process pipe or static mixer.

B. Related Sections:
   1. Section 40 23 19 - Pipe and Pipe Fittings
   2. Section 40 23 20 - Valves and Piping Specialties

### 1.2 SUBMITTALS:

A. Manufacturer's literature and certified drawings of showing dimensions, connections, capacities, method of anchorage, materials of construction, and coatings.

B. Shop drawings and manufacturer's literature shall be of sufficient detail to determine compliance with the plans and specifications.

C. Prior to start-up of equipment, the manufacturer shall provide two (5) copies of operation and maintenance manuals for the equipment submitted herein.

### 1.3 SPARE PARTS

A. Provide the following spare parts in well-marked boxes with model and manufacturer identification:
   1. As recommended by the manufacturer.
   2. Provide one (1) complete spare injector.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Chemical Injector:
   1. Injectors shall be retractable type as manufactured by Hayward, or approved equal, and shall include the following:
      a. 1" CPVC ball valve.
      b. 1/2" diameter male inlet connector with CPVC quick release coupling.
      c. Integrated spring loaded ball check valve compatible with chemical to be injected.
      d. Stainless steel limit chain.
      e. 1/2" diameter CPVC tube material, with 45o bevel tip, and of the length required to inject chemical in the center of the pipe (varies per application).
      f. Pressure rated to 150 psig minimum.

## PART 3 EXECUTION

### 3.1 INSPECTION AND TESTING

A. Preliminary Inspection/ Testing:
   1. Initial Tests:
      a. Test all injectors using potable water. Demonstrate injectors are operable and leak-free.

b. Some chemicals may react with process water and may cause excessive heat, which can damage piping and valves. Utilizing low pressure clean air supply, purge all water out of the system up to the application point. Then reconnect piping and fill with chemicals.

**END OF SECTION 43 32 69**

# SECTION 44 09 10

# GENERAL PROCESS MECHANICAL REQUIREMENTS

## PART 1 GENERAL

### 1.1 SUMMARY

The provisions of this entire section of the specifications are intended to govern the quality of design, fabrication, workmanship, operation, etc., of all materials, equipment and appurtenances to be furnished and installed under the various sections of the process mechanical specifications and all other sections that include process mechanical equipment as part of the specified items.

### 1.2 SUBMITTALS

A. Shop Drawings and Product Data

Shop drawings, including dimensioned drawings, descriptive literature, performance data, electrical characteristics, and in general all information necessary to provide compliance with the specifications, shall be submitted as required in Section 01 33 00.

B. Maintenance Data and Operating Instructions

Submit an Operation and Maintenance Manual for the equipment furnished including a detailed description of the function of each principal component, procedures for operation, instructions for overhaul and maintenance in accordance with the Standard Specifications. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

### 1.3 GUARANTEE

All materials, equipment, workmanship and performance shall be guaranteed for the period and in accordance with the provisions of the Standard Specifications.

### 1.4 MANUFACTURERS OPERATION AND MAINTENANCE MANUALS

The Contractor shall provide manufacturer's operation and maintenance manuals as required in Section 01 00 00.

### 1.5 STANDARDS

Where standards, codes or specifications are referred to, the reference is to particular standards, codes or specifications together with all the latest amendments and errata applicable at the time the bids are taken. These are listed below:

| | |
|---|---|
| I.E.E.E. | Institute of Electrical & Electronics Engineers |
| A.S.T.M. | American Society for Testing Materials |
| A.S.M.E. | American Society of Mechanical Engineers |
| A.N.S.I. | American National Standards Institute |
| A.W.S. | American Welding Society |
| A.W.W.A. | American Water Works Association |

| | |
|---|---|
| N.F.P.A. | National Fire Protection Association |
| N.E.M.A. | National Electrical Manufacturer=s Association |
| Federal | Federal Government Specifications |
| O.S.H.A. | Occupational Safety and Health Act |
| U.L. | Underwriters Laboratories |
| A.A.B.C. | Associated Air Balance Council |
| A.D.C. | Air Diffusion Council |
| A.G.A. | American Gas Association |
| A.R.I. | Air Conditioning and Refrigeration Institute |
| C.S. | Commercial Standard |
| I.B.R. | Institute of Boiler and Radiator Manufacturers |
| M.S.S.P. | Manufacturers Standards Society of the Valve and Fitting Industry |
| S.M.A.C.N.A. | Sheet Metal and Air Conditioning Contractors National Association |
| N.E.C. | National Electrical Code |

**1.6 GENERAL DESIGN OF EQUIPMENT AND MACHINERY**

A. All equipment and machinery furnished under this contract shall be of the latest and most improved design suitable for the service of which it is to be used. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of labor, power, maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum noise, wear and vibration (maximum amplitude of 2.0 mils unless otherwise specified) when properly installed.

B. Ample room for erecting, repairs, inspecting and adjusting all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.

C. The design and construction of the several units shall be such that they shall present a uniform appearance and the arrangement shall be such that their operation shall be in harmony in every respect. Whenever possible, fittings and fixtures of the same make and model shall be used for the several units and their connections. All equipment of identical type and service shall be the product of the same manufacturer.

D. All equipment selected shall be of such size and general arrangement to suit the space in which it is to be installed.

E. The various parts of the equipment and machinery shall be of plain shape and good lines, especially designed and constructed for strength and durability. Casting shall be designed and constructed to cool uniformly without shrinking strains and shall have good sized fillets at all re-entrant corners. Sudden change of section shall be avoided.

F. Whenever possible, part of each unit shall be made to gauge and be a duplicate of and interchangeable with the same parts of other machines of the same size and kind.

G. The workmanship shall be of the highest class throughout.

H. All assembles shall be completely shop fabricated and structural steel parts shall be shop erected. Assemblies and structural steel parts shall be matchmarked before being disassembled for shipment. Parts shall be shipped assembled in as large unit as possible to minimize field reassembly. All parts shall

be amply proportioned for all stresses which may occur during operation, and for any additional stresses which may occur during fabrication and erection.

I. Unless otherwise specified, welding shall be in accordance with the latest standard specifications for "Gas Tight Welding" of the American Welding Society.

J. Unless otherwise specified, galvanizing shall be hot-dipped in accordance with the latest standard specifications for "Zinc Coating" of the ASTM, Serial Designation A-123.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Unless otherwise specified, materials shall be in accordance with the following latest Standard Specifications of the ASTM:

| | |
|---|---|
| Structural Steel | A-36 |
| Welding Steel Pipe | A-53 |
| Iron Castings | A-48 |
| Babbitt | B-23 |
| Bronze Castings | B-30 |
| Bronze (Manganese) | B-138 |
| Bronze (Silicone) | B-98 |
| Steel Bolts | A-307 |
| Hot Dip Zinc Coating | A-123 |
| Stainless Steel Bolts | A-193, Grade B, Type 2 |

B. All materials shall, if required, be tested and shall fulfill all requirements specified. Physical tests may be made by the County. The Contractor at his own expense shall furnish test pieces and samples in the number, shape, size and finish required by the Engineer. All broken material shall become the property of the County. The failure of test specimens to fully conform to the requirements of the specifications shall be sufficient cause for rejection of the whole melt or stock from which samples were obtained.

C. Iron castings shall be smooth, clean and free from scale, lumps, blisters and other defects. No plugging, welding or filling will be allowed.

D. The alloy grade number of all babbitt shall be that bearing alloy of a composition recommended by the manufacturer of the equipment or machinery for the service required, subject to the approval of the Engineer.

E. All bronze shall be made of new material and shall be free from objectionable imperfections. If the materials show signs of improper mixing when being machined, the castings will be rejected.

### 2.2 JOURNALS, BEARINGS AND KEYS

A. Journals and bearing surfaces shall be of sufficient size and properly proportioned for the least wear and to avoid heating under all conditions, and where necessary, provisions shall be made for each removal and for proper adjustments. Journals shall be suitable boxes which, where necessary, shall be lined with babbitt metal hammered into grooves and bored in place. If bearings are of the ball bearing type, both inner and outer races as well as the balls shall be heat treated steel to resist wear. The balls shall be of ample size to carry the maximum loads with a large factor of safety to prevent flaking,

spalling, or crushing. The balls shall be properly spaced and held in position by rugged continuous spacing or retainer rings.

B. Pins and keys shall be properly proportioned. Keys, nuts and all other parts which might otherwise work loose shall be secured with approved locking devices.

## 2.3 LUBRICATION

A. All bearings, except those specifically requiring oil or water lubrication shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the Zerk type as made by Alemite, or equal. The pattern of the fitting shall be selected for accessibility in lubricating and shall meet the approval of the Engineer. Housings of grease lubricated bearings shall be automatically exhausted to atmosphere to prevent excessive greasing. The Contractor shall furnish three grease guns.

B. The Contractor shall furnish lubrication charts or schedules for each piece of equipment or machinery. The charts or schedules shall designate each point of lubrication, the type and quantity of lubricant to be applied and the frequency of lubrication. Charts and schedules shall be submitted to the Engineer in quadruplicate, bound in folios, with each chart or schedule protected by a transparent plastic envelope.

C. The Contractor shall furnish one (1) year=s supply of each type of lubricant. A typewritten list shall be furnished with the lubricants, designating the specific lubricant to be used for each piece of equipment. This is in addition to the required operating and maintenance manuals which will also contain lubrication requirements.

## 2.4 MOTORS AND CONTROLS - GENERAL

A. Motors and controls shall conform to the latest requirements of IEEE and NEMA, and where applicable, shall be UL listed. Minimum sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG 1.

C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplate.
2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overload, without exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total $WR^2$ of the driven equipment to operating speed.
3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.

4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than 3/4 horsepower shall be single phase, and motors 1 horsepower and larger shall be 3 phase.
5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.

D. Single phase motors smaller than 1/20 horsepower shall be ball or sleeve bearing, drip-proof, totally enclosed or explosion proof, as specified, 115 volts, permanent split capacitor or shaded pole type. These motors shall not be used for general power purposes and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers.

E. Single phase motors 1/20 horsepower and larger shall be ball bearing, drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115, 115/230, 200 or 230 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type.

F. Except as otherwise specified in the various specification sections, 3 phase motors shall meet the requirements of this paragraph. Motors shall be NEMA design B squirrel cage induction type. Insulation shall be Class F and motor shall be rated at no greater than 50 degrees C rise for open motors and 65 degrees C rise for closed motors both above an ambient temperature of 45 degrees C. At 40 degrees C ambient temperature explosionproof and totally enclosed motors shall have a 1.00 service factor and dripproof motors shall have a service factor of 1.15 or higher. Motors specified for operation at 480 volts shall be nameplated 460 volts.

G. Minimum efficiencies for three phase standard efficient motors at full load having nominal rated speeds of 1200 RPM and higher, 600 volt or less, shall be as follows per NEMA MG1-2006, Section II, Part 12, Table 12-11:

| Horsepower | Minimum Efficiency |
|---|---|
| 1 | 80.0 |
| 1-1/2 | 85.5 |
| 2 | 86.0 |
| 3 | 87.5 |
| 5 | 87.5 |
| 7-1/2 | 89.5 |
| 10 | 89.5 |
| 15 | 90.2 |
| 20 | 90.2 |
| 25 | 91.7 |
| 30 | 91.7 |
| 40 | 93.0 |
| 50 | 93.0 |
| 60 | 93.6 |
| 75 | 93.6 |
| 100 | 94.1 |
| 125 | 94.1 |
| 150 | 95.0 |
| 200 | 95.0 |
| 250 | 95.0 |
| 300 | 95.0 |

| | |
|---|---|
| 350 | 95.0 |

Three phase motors shall be E-plus Energy Efficient Standard Duty Motor of the Electric Motor Division of A.O. Smith, the MAC II High Efficiency motor of Westinghouse Electric Corporation, the equivalent product of Baldor Company, or equal.

H. Minimum efficiencies for three phase premium efficient motors at full load having nominal rated speeds of 1200 RPM and higher, 600 volt or less, shall be as follows per NEMA MG1-2006, Section II, Part 12, Table 12-12:

| Horsepower | Minimum Efficiency |
|---|---|
| 1 | 82.5 |
| 1-1/2 | 86.5 |
| 2 | 87.5 |
| 3 | 88.5 |
| 5 | 89.5 |
| 7-1/2 | 90.2 |
| 10 | 91.7 |
| 15 | 91.7 |
| 20 | 92.4 |
| 25 | 93.0 |
| 30 | 93.6 |
| 40 | 94.1 |
| 50 | 94.1 |
| 60 | 94.5 |
| 75 | 94.5 |
| 100 | 95.0 |
| 125 | 95.0 |
| 150 | 95.4 |
| 200 | 95.4 |
| 250 | 95.4 |
| 300 | 95.4 |
| 350 | 95.4 |

Three phase motors shall be manufactured by U.S. Motor, GE, or equal.

I. Motors seventy-five (75) horsepower and larger shall be as specified with the driven equipment in these specifications.

J. Belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension. All fan motors shall have adjustable sheaves for speed adjustment

## 2.5 FLANGES AND BOLTS

A. Flanges, except as otherwise specified, shall be cast solid, and bolt holes shall be drilled and spot-faced on the back. Stud holes shall not be drilled through. Flanges shall be uniform in thickness and shall come fair and, if required, shall be turned or chipped in a neat and workmanlike manner.

B. Jacking screws shall be provided for covers, etc. where required, and also suitable eye bolts for lifting. Bolts and nuts shall be of the best quality of open hearth, free machining steel. Bolts shall have good,

sound well-fitting threads; nuts shall be cold pressed. All heads, nuts and threads shall be of the American Standard regular sizes. All ferrous bolts and nuts shall be galvanized by the hot dipped process.

C. Bolts and nuts connecting pumps, valves and meters ( as in flange connections) shall be Stainless Steel-Grade 416.

## 2.6 COUPLINGS

A. Except where otherwise specified for a particular item of equipment, all equipment where flexible couplings are specified or are required for the purpose, a standard non-lubricated, elastomeric flexible coupling shall be provided between each motor and its driven equipment. One hub of the coupling shall be firmly fixed and keyed to the equipment shaft with the other hub similarly secured to the abutting drive shaft. Couplings shall be placed as close as possible to the driven equipment and the motor bearings to make compactly arranged units. Arrangement of couplings shall be such that there is sufficient room to place a dial indicator for alignment checking of shafts of the motor driven equipment. Each coupling shall be provided with an easily removable guard meeting all OSHA requirements.

B. All equipment and motors/drives shall be field aligned using laser alignment equipment in accordance with the procedures established by the latest revision of the Hydraulic Institute Standards. Parallel and angular misalignment shall not exceed the limits specified by the County.

## 2.7 EQUIPMENT BEDPLATES

The various items of motor driven equipment, such as pumps, shall be mounted on structural steel bedplates. The bedplates shall be adequate size to accommodate the equipment and its motor, to form an integral rigid mounting platform. Stainless steel, precision precut shims shall be used to level equipment bedplates mounted in contact with concrete pads or floors. Jacking bolts or jacking (leveling) nuts on mounting studs shall not be used in lieu of shims. Bedplates shall be grouted to the concrete base and shall be filed with grout. The manufacturer shall make provision for introducing grouting mixture into bedplate cavities. It shall be the contractor's complete responsibility to determine the proper method, to provide all materials and components required, and to coordinate the work, to set, couple, align and install all equipment in a satisfactory manner.

## 2.8 VIBRATION PERFORMANCE TESTING

A. Return activated sludge pumps and positive displacement rotary lobe blowers shall be field tested for vibration by the Contractor in accordance with Appendix D of these specifications.

# PART 3 EXECUTION

## 3.1 MANNER OF INSTALLATION

A. The general arrangement of pipe and equipment shall be as shown on the drawings. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted to the Engineer for approval. The Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment as indicated, without substantial alteration. Because of the small scale of the drawings, it is not possible to indicate the exact location of piping, all offsets,

fittings and accessories which may be required. The Contractor shall carefully investigate the space requirements for proper clearances and the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing such offsets, fittings, valves and accessories as may be required to meet such conditions.

B. Each trade shall determine the location, size, etc. of all chases and openings required for the proper installation of its work, and shall see that such are provided. Where it is necessary to run pipes or ductwork through walls or fittings, the trade performing the work shall notify the Contractor so that proper provisions can be made for same. Each trade shall furnish and set all inserts, sleeves, hanger supports, etc. required for its work and shall be responsible for their proper and permanent location.

C. All piping and ductwork exposed to view shall be run generally parallel with the lines of the building and as close to walls and column as may be practical and consistent with proper grade and the maintenance of proper clearances for access to all parts requiring servicing.

D. The Contractor, in the prosecution of the work, shall do no cutting of woodwork, masonry, concrete or other materials after same have been installed, without the written permission of the Engineer. No waterproofing shall be cut for any purpose except on written approval of the Engineer.

## 3.2 TESTING

A. After erection, the Contractor shall adjust and balance all equipment and systems, and shall demonstrate that all equipment is operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly, without vibration, overheating, or sign of distress at full specified capacity. Adjustments shall be made as necessary. All defective parts on machinery shall be replaced.

B. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction.

## 3.3 MISCELLANEOUS

A. Finished parts shall be well protected in the shop, during transportation and before and after erection to prevent injury of any kind. Injured parts which in the opinion of the Engineer are damaged or which cannot be refitted, shall be promptly replaced by the Contractor without expense to the Owner. All exposed finished parts of machinery shall be greased or oiled before shipment.

B. The Contractor shall furnish all tools of special nature which are required for making adjustments (by the Owner after the work has been turned over to him) to equipment, but will not be required to furnish standard tools.

C. All exposed belts, gears, and drives shall be protected with guards. Guards may be of the equipment manufacturer=s standard design, but must meet all the OSHA Standards.

## 3.4 PAINTING AND LABELING

A. All fabricated or assembled surfaces normally painted shall be thoroughly dry and free from all rust, grease, dirt or scale. The Contractor is reminded to correlate the selection of shop prime coats to be compatible with subsequent field applied coats of paint. The Contractor shall touch up paint any item damaged during shipping or installation.

B. Each piece of equipment (including mechanical operators, and electrical switches for the equipment) shall be identified as specified in section 10400 to indicate the service or function. Unless specified otherwise in the mechanical and electrical sections of these specifications, each motor and motor controller shall be similarly numbered (or lettered) to correspond to the number (or letter) of the driven unit.

**3.5 ADJUSTMENTS TO RELATED WORK**

The final work shall include any adjustment that may be required by the approved equipment furnished, with modifications made to concrete shapes and to dimensions shown on the contract drawings as may be required to suit the details of the approved equipment furnished, all at no additional cost to the County.

**END OF SECTION 44 09 10**

**SECTION 44 23 31.24**
**UTILITY WATER SYSTEM**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of this section includes, but is not limited to, submersible utility water pump station with wet well, submersible pumps, piping, separate valve vault, and all appurtenances for a complete installation. The utility water pump station wet well and valve vault will be precast concrete construction.

### 1.2 QUALITY ASSURANCE

A. Submersible Pump Design Criteria (each pump):
   UTILITY WATER PUMP STATION
   1. Capacity: 0 GPM @ 185'+ TDH Shutoff Head
      60 GPM @ 174' TDH Design Point
   2. Motor: 10 HP minimum Non-overloading
      @ Shutoff head to 150'TDH
      460 V, 3-phase, 60 Hz 3600 RPM maximum
   3. Pump Discharge: 1.5" diameter minimum

B. All electrical equipment installed in a wet well must be UL approved to meet the requirements for use in Class 1, Group D, Division 1 locations as defined in Article 500, "Hazardous Locations" of the National Electric Code (NEC) of the National Fire Protection Association (NFPA).

C. Pumps shall be Model KRT K 40-252/72XEG-S IE3 manufactured by KSB, or equal.

### 1.3 SUBMITTALS

A. Equipment Certification: At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification attesting that the manufacturer has examined the Contract Drawings and Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

B. Shop Drawings and Product Data:
   1. Submit the required number of copies of certified detailed installation shop drawings for basin assembly, pumps, piping, controls and accessories including wiring schematics.
   2. Submit manufacturer's latest published literature for all materials specified under this Section.
   3. Before shipment, submit certified pump curves showing head/capacity relationships after pump assemblies have been fabricated and performance tested at the factory. Submit certified results of all start-up and performance tests.
   4. Submit calculations for the wet well and valve vault which verify that each structure's weight is sufficient to counteract hydrostatic uplift using a 1.5 safety factor.

C. Maintenance Data and Operating Instructions: At time of delivery, submit the required number of copies of Operation and Maintenance Manuals for the pump station furnished including a detailed description of the operation of each principal component, procedures for operation, instructions for overhaul and maintenance, lubrication schedule, safety precautions, test procedures, and parts lists.

D. Maintenance Material (Spare Parts):

1. At time of delivery, provide one complete set of manufacturer's recommended spare parts for each pump and motor assembly, including pump mechanical seals, bearings, bushings and gaskets.
2. Package each part individually or in sets in moistureproof containers or wrappings, clearly labeled with part name and manufacturer's part/stock number.
3. Provide any special tools required for equipment maintenance.

**1.4 FIELD SERVICES**

A. Provide the services of a manufacturer's representative experienced in the installation and operation of the pumping station supplied under this specification for not less than two 8-hour workdays on-site for installation inspection, start-up, and instructing Owner's operating personnel.
B. Provide for the above services to be performed during two separate visits to the project site.

**PART 2 PRODUCTS**

**2.1 SUBMERSIBLE PUMPS**

A. General Description: Complete utility water pumping station consisting of 2 submersible treated wastewater effluent pumps for duplex pumping stations, discharge piping, hydraulically sealed pump discharge flanges, discharge piping, pump mounting plate with bottom rail supports, upper rail supports, lift out rails, pump lifting chains, access hatch, and other necessary appurtenances. Discharge check valves and plug valves contained within a separate valve vault adjacent to the pumping station.
B. Pump Construction:
   1. Motor Housing: Grey Cast Iron, ASTM A-48, Class 35B.
   2. Casing: Grey Cast Iron, ASTM A-48, Class 35B.
   3. Impeller: Grey Cast Iron, ASTM A-48, Class 35B.
   4. Casing Wear Ring: Grey Cast Iron, ASTM A-48, Class 35B.
   5. Motor Shaft: Stainless steel, ASTM A-276 Type 420.
   6. Hardware: Stainless steel, ASTM A-276 Type 316.
   7. "O" Rings: Nitrile rubber (NBR)
   8. Mechanical Seals: Double mechanical seal
      a. Pump-side Silicon carbide / Silicon carbide
      b. Bearing-side, Carbon / Silicon carbide.
   9. Lubrication: Grease lubrication. Lubricated for lifetime.
   10. Solids Size: 9/16 inch".
   11. Main Cable: Waterproof synthetic rubber compound outer sheath, 1 x AWG 15-12
C. Pump Motors:
   1. Sealed Submersible explosion proof. NEMA G, Class F insulation; Class 1, Groups C and D, 1.15 service factor, motor to be non-overloading throughout the pumps entire performance range without exceeding a 1.0 service factor.
   2. Mechanical double seal, self-aligning, double floating, oil-lubricated. Lower faces shall be silicon carbide; upper faces shall be carbon and silicon carbide; elastomers shall be Viton.
   3. Mount an electrode between seals to detect water leaking into seal chamber and actuate a light on the control panel.
   4. Integral stainless steel motor and pump shaft.

5. Upper and lower ball bearings to support rotor; lower bronze sleeve or ball bearing to take radial loads from impeller; minimum ball bearing B-10 life of 50,000 hours.
6. Stainless steel fasteners.
7. Protect motor with a heat sensor thermostat to stop motor if overloaded; thermostat to reset automatically when temperature drops to a safe level.
8. Motor leads potted in epoxy compound to form leakproof seal.
9. A secondary rubber pressure grommet shall be provided as an additional sealing point and strain relief at the point of cable entry.

**2.2 PUMP DISCHARGE ASSEMBLY**

A. Provide a hydraulically sealed non-sparking quick disconnect discharge flange and 90 degree elbow for each pump.

**2.3 WET WELL**

A. Precast concrete construction in accordance with Section 03 40 00 of these Specifications.
B. Weight of structure shall be sufficient to prevent hydrostatic uplift when surrounding water level is at the top of the wet well.

**2.4 PUMP APPURTENANCES**

A. Pump Guide Rails: 2" stainless steel.
B. Pump Guide Rail Braces/Supports: Stainless Steel.
C. Pump Lifting Cables: 316 Stainless Steel.
D. Fasteners and Hardware: 316 Stainless steel.
E. Pump Base and Elbow: Grey Cast Iron, ASTM A-48, Class 35B.

**2.5 VALVE VAULT**

A. Precast concrete conforming to Section 03 40 00 of these Specifications, complete with aluminum hatch, aluminum ladder, floor drain with trap, and inlet and outlet pipe openings as indicated on the Contract Drawings.

**2.6 WET WELL AND VALVE VAULT ACCESS HATCHES**

A. Aluminum, flush, channel frame type. Valve vault hatch shall be single leaf. Wet well hatch shall be single or double leaf. Access hatch shall open so as not to interfere with pump lift out.
B. 1/4" extruded aluminum channel frame with anchoring flange. 1-1/2" channel drain.
C. Minimum 1/4" thick diamond checkered aluminum plate covers, designed for minimum 300 lbs/sq.ft. loading. Heavy bronze hinges, stainless steel hinge pins, spring-operated lifting mechanism, automatic hold-open arm with release handle.
D. Stainless steel inside snap lock, removable key-wrench lifting handle.
E. Finish: Standard mill finish.
F. Shop coat portions of the frame which may contact or be embedded in concrete with a heavy coat of bituminous paint.

**2.7 VALVE VAULT LADDER**

A. Ladder shall conform to OSHA/ANSI A14.3 standards for fixed wall ladders.

B. Ladder, unless otherwise shown on Drawings, shall be 16" clear between stringers with maximum rung spacing of 12".
C. Mounting brackets shall be bent plates not less than 2-1/2" x 3/8" of dimensions to allow a 7" clearance from wall; brackets shall be spaced not more than 6' centers.
D. Aluminum Ladder:
   1. Stringers either 3" channels with minimum thickness of .125" or flats 2-1/2" x 3/8", alloy 6061-T6.
   2. Provide 1-1/8" flat, serrated rungs, secured to stringer.
   3. All ladder components alloy 6061-T6.
   4. Standard mill finish.
   5. All anchor bolts for aluminum ladders shall be stainless steel, Type 304.
E. Provide safety extensions (ladder-up).
F. Design Load: Design ladder rungs to support a concentrated center load of 1000 pounds.

**2.8 PORTABLE HOIST**

A. Provide one (1) portable hoist and flush mount hoist socket base for removal of the pumps. The hoist shall be of galvanized steel construction. The socket bases shall be of stainless steel construction. The hoist shall have a 500 lb. load rating with a 2.0 safety factor based on the minimum yield strength of materials and components. The boom shall rotate 360 degrees on the mast center and shall be affixed to the mast with pins that allow easy disassembly. The boom angle shall have two positions of adjustment. In position No. 1, the boom shall have a reach (centerline of mast to centerline of hook) of 42" and a clear height (floor to hook) of 21". In position No. 2 the boom shall have a reach of 35" and a clear height of 43".
B. Provide the hoist with a manually operated winch having machine cut spur gearing with steel covers, bronze bearings and friction disc, and a Weston type load brake. Wire rope shall be 18-8 stainless steel with stainless steel thimble and latch type hook. Provide wire rope with a quick disconnect drum fitting. Wire rope shall provide a 20' lift.
C. The socket bases shall be provided with a removable stainless steel cover.
D. Portable hoist shall be Thern Model 5122M1GAL with Model 522SSF socket base with cover or equal.

**2.9 ANCHOR BOLTS**

A. Unless otherwise noted on the Drawings, furnish stainless steel anchor bolts and associated fasteners for interior and exterior applications. Anchor bolt sizing to be as shown on Drawings. Anchor bolt sizes not shown on Drawings shall be as recommended by manufacturer of equipment being anchored. Minimum anchor bolt length 3" with minimum 6" embedment. Provide a minimum of 1/2" bolt projection beyond anchor bolt nut. Furnish flat washer with each anchor bolt. Unless otherwise indicated, all anchor bolts to be embedded type. Set prior to concrete placement.
B. Expansion or adhesive type anchor bolts may be utilized where indicated on the Drawings. Expansion bolts shall meet the requirements of 2.06.A except bolts shall have a 4" minimum embedment and conform to Federal Specification FF-S-325, Group II, Type 4, Class I for concrete expansion anchors.

**2.10 DUCTILE IRON PIPE**

A. See Section 40 23 19.

**2.11 PIPE ACCESSORIES**

A. Wall Sleeves and Wall Pipes:
   1. Cast Iron: ASTM A48, Class 30B
   2. Ductile Iron: ASTM A536, Grade 60-40-18
   3. Mechanical Joint, ANSI/AWWA C111/A21.11
   4. Integral cast intermediate wall collar

B. Wall Seals:
   1. Assembly of synthetic rubber links connected with corrosion resistant bolts; when the bolts are tightened, Delrin plastic pressure plates compress the rubber links to fill the annular space between the pipe and the wall sleeve to form a watertight seal.
   2. All wall seals located in penetrations through new walls that are below grade shall be installed in a cast iron wall sleeve that conforms to the requirements of this specification section or installed in a steel wall sleeve. This steel wall sleeve shall consist of a piece of standard weight steel pipe with an integral steel anchoring collar. This anchoring collar shall be 1/4" thick, shall project 3" beyond the pipe outer wall and shall be welded to the pipe around its entire periphery. No sleeves are required if hole is core drilled through a new or existing concrete wall.
   3. Century-Line prefabricated sleeves as manufactured by the Thunderline Corporation, Belleville, Michigan may be used in lieu of steel or cast iron sleeves for wall seal application.

C. Coupling Adapters:
   1. Factory pre-assembled couplings for plain-end pipe.
   2. Double-ring, steel followers, rubber compounded wedge-gasketed, steel flared middle ring type mechanical joint, ANSI/AWWA C111/A21.11.

**2.12 VALVES**

A. Flanged Joint Swing Check Valves: Iron body, bronze mounted, stainless steel hinge pin, horizontal swing check type. External lever with spring. Renewable disc. AWWA C508. Valves 2" to 12", 150 psi working pressure; valves 14" to 24", 175 psi working pressure. Provide rubber faced clappers. Spring tension shall be adjustable.
   1. Provide check valves designed so that all parts may be removed for inspection or replacement through the top of the valve with the valve in position.

B. Plug Valves:
   1. Semi-steel body, flanged or mechanical joint ends. Eccentric plug, rectangular or semi-circular ports. For 4" diameter and smaller plug valves, where rectangular port is furnished, the cross-sectional area shall be not less than 100% of the connecting pipe cross-sectional area.
   2. Plug valves shall have a cast iron plug having a resilient neoprene or Buna-N facing. Valve bodies shall be furnished with an 1/8" minimum welded overlay seat of not less than 90% pure nickel. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Valves shall have corrosion resistant bearing. Valve shaft seals shall be in accordance with AWWA C504 or C507. Valve housing shall be constructed such that a leak through the shaft seal is free to drain to atmosphere and will not flood the gear actuator. Valves shall have a 150 psi working pressure. Sizes 4" and smaller lever actuated; sizes 6" and larger provide with manual handwheel gear actuators.
   3. Gear Actuators:

a. Gearing oil lubricated, enclosed in a semi-steel sealed housing. Actuator shaft and quadrant supported on permanently lubricated bronze bearings. Stainless steel nuts, bolts, springs and washers.
b. Valve position indicator. Adjustable closing torque stop.
c. Mounting brackets for buried or submerged service totally enclosed and with gasket seals.

C. Flapper Valve:
1. Flap valve mounted on pipe ends shall be supplied with a 125 lb. pattern flange and mounted to the pipe using neoprene rubber gaskets and T-316 stainless steel bolts. The body of the flap gate shall be made of reinforced copolymer of a formulation suitable for the service intended.
2. The body of the valve shall not be less than 1/4" thick for sizes 12" and smaller, and 1/2" thick for larger sizes.
3. The rubber flap shall be made of 60 durometer molded neoprene, with a hinge suitably reinforced with encapsulated fabric to prevent any water from contacting the fabric. A weight shall be molded into the rubber to aid in proper quick closure and to prevent rubber distortion.
4. The rubber flap shall be held in place with a clamp bar and T-316 threaded fasteners no smaller than 5/16" diameter.
5. The rubber hinge/flap assembly shall be readily replaceable while the valve is in service.
6. Provide a stainless steel cable attached to the flap with a stainless steel swivel snap hook. The stainless steel cable shall reach to the wet well access hatch and attach to a stainless steel eye bolt via a stainless steel snap hook.
7. The flap valve shall be as manufactured by Plasti-Fab, Inc., or equal.

D. Pressure Sustaining Valve:
1. Full port, single chamber with one-piece disc and diaphragm assemby. The assembly is the only moving part within the valve allowing it to open, close, or modulate as commanded by the pilot control system.
2. Body & Cover: Ductile Iron ASTM A536
3. Coating: NSF Listed Fusion Bonded Epoxy Lined and Coated
4. Trim: 316 Stainless Steel
5. Elastomers: Buna-N
6. Stem, Nut & Spring: Stainless Steel
7. Pressure sustaining valve shall be ACV F100 as manufactured by Watts, or equal.

## 2.13 BASKET STRAINER

A. Standard simplex basket strainer with large capacity basket, machined basket sat, threaded drain, and perforated basket.
1. Material: Iron
2. End Connections: Flanged 125 lb.
3. Seals: Buna-N
4. Pressure Rating 200 psi @ 100 F

B. Basket strainer shall be Model 72 as manufactured by Eaton, or equal.

## 2.14 VALVE BOXES

A. Three-piece, cast iron, adjustable. 5-1/4" diameter. Heights as indicated.

**2.15 CONTROLS**

A. See Division 25.

**2.16 ELECTRICAL REQUIREMENTS**

A. See Division 16.

**2.17 MATERIALS PROTECTION**

A. Coat pumps, pump discharge piping, and valve vault piping in accordance with specification Section 09 90 00.

B. Shop coat the exterior of pump basin and valve vault with bitumastic compound. Koppers Bitumastic No. 50 or equal.

**2.18 BLACK AND GALVANIZED STEEL PIPE (GENERAL USE)**

A. Pipe: ASTM A52, Seamless. Schedule 40, unless otherwise indicated on the Contract Drawings.

B. Fittings:
   1. Threaded: Malleable Iron, ANSI B16.3, 150# Class.
   2. Flanged: Cast Iron, ANSI B16.1, 125# Class.
   3. Socket Welded: Forged Steel, ANSI B16.11.

C. Flanges: AWWA C 207.

D. Unions: Threaded, forged carbon steel, MSS SP-83.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Install the pumping equipment where indicated on the Contract Drawings and in accordance with the manufacturer's instructions and the approved shop drawings. Use wall sleeves with wall seals to seal all pipe penetrations through the pump station and valve vault walls.

B. Provide and connect accessories, power and control conduit and wiring as required to ensure a complete operable system as intended.

C. Obtain and provide the Owner with an Installation Certificate signed by the equipment manufacturer's representative attesting that the equipment has been properly installed and is ready for start-up and performance testing.

**3.2 PRE-OPERATION CHECK**

A. Test the pump basin for leakage in accordance with Section 33 01 32.

B. Make the following checks before operating pump:
   1. Assure that piping and basin are clear of debris which might clog pump.
   2. Check level switch settings.
   3. Check for proper motor rotation.

**3.3 PERFORMANCE TESTING AND ADJUSTMENT**

A. Operate the pump station using clear water at the design point through two complete pumping cycles, under the supervision of the manufacturer's representative and in the presence of the Engineer. Check pump and motor for excessive vibration and high bearing temperatures. Demonstrate correct sequence of pump operation. Check for motor overload by taking ampere readings.

B. Verify pump performance by timing how long it takes to drawdown a specific volume of liquid and measuring the pump discharge head with a pressure gauge. Provide written pump performance test results and pump curve to Owner.

C. Demonstrate provision for pump removal and replacement.

**3.4 EQUIPMENT ACCEPTANCE**

A. Adjust, repair, modify or replace any components which fail to perform as specified and rerun the tests. Make final adjustments under the direction of the manufacturer's representative and to the satisfaction of the Engineer.

**END OF SECTION 44 23 31.24**

# SECTION 44 42 42

# MIXERS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This section includes requirements for furnishing and installing a new low-speed submersible mixer (type propeller) and appurtenances in the new pre-anoxic tank and influent equalization tank in accordance with the contract requirements.

B. The mixers will be supported from the floor and wall of the tanks tank.

C. The mixers shall be submersible with motors and gearboxes as specified herein.

D. The guide rail arrangement shall permit the mixer to be easily adjusted for flow and energy optimization.

E. Equipment furnished under this section shall be designed to operate continuously, 24 hours a day, 365 days per year.

F. Intended purpose: The mixers shall be used for mixing ballasted activated sludge (containing magnetite) and raw wastewater with total suspended solids concentrations up to 6,350 mg/l (including magnetite) in the pre-anoxic tank. The mixers shall be used for mixing raw wastewater in the influent equalization tank. The mixing system shall provide nearly uniform concentrations throughout the tanks.

### 1.2 SUBMITTALS

A. Layout drawings

B. General arrangement drawings, installation drawings, installation instructions, electrical schematics, wiring and control diagrams, shop drawings, data sheets, catalog cuts, and other such information shall be furnished for review and approval on all equipment and material specified within. Show complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners, and other details.

C. Manufacturer's installation recommendations.

D. The manufacturer shall furnish Operation and Maintenance manuals for all of the equipment specified.

E. Design calculations demonstrating the equipment process design requirements are met.

F. Equipment Certification Form as provided on the next page.

G. Certification of Materials and Installation

H. Equipment Certification

At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification for the Mixers attesting that the manufacturer has examined the Contract Drawings and

Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

## 1.3 QUALITY ASSURANCE

A. The manufacturer shall perform the following inspections and tests on each mixer before shipment:
   1. An insulation test of the windings.
   2. A balancing of the motor (rotor).
   3. A test of the motor (run dry for 5 minutes at full load) to verify electrical data measurements. All electrical data shall be registered as part of documentation.
   4. A submerged test of the mixer where mixer casing is exposed to an over pressure of 15 PSI.
   5. A motor and cable insulation test for moisture content and insulation defects.
   6. A dry run test to verify correct rotation and mechanical integrity. The entire unit is checked for vibration.
   7. A final inspection of propeller, motor rating, and electrical connections for compliance with purchase order.

B. The mixers shall be a product of a manufacturer experienced in the design and fabrication of equipment of this type and purpose. The manufacturer shall provide evidence of having supplied similar equipment which has been operating successfully for at least five years and meeting or exceeding the performance and design requirements specified.

## 1.4 SPARE PARTS AND SPECIAL TOOLS

A. One set of special tools required for normal operation and maintenance shall be provided.

B. The following spare parts shall be packaged for storage, labeled, and provided:
   1. One set of rubber buffers per mixer type provided.
   2. One shaft holder for each shaft diameter provided.
   3. All lubricating oils required for the first year of operation.

## 1.5 WARRANTY

A. The equipment shall be warranted for a period of one year from the date of substantial completion as defined in the General Conditions to be free from defects in workmanship, design or material.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 42** AND CERTIFIES THAT THE **"MIXERS"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 42**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.
EQUIPMENT: **" MIXERS"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

**PART 2 PRODUCTS**

## 2.1 SYSTEM DESCRIPTION

A. A low speed submersible mixer (type propeller) shall be installed in the pre-anoxic tank as shown on the Contract Drawings and specified herein. The pre-anoxic tank is part of an integrated activated sludge process in which magnetite is used as a ballast. The mixers shall each be designed for continuous operation.

B. Performance Requirements

1. The mixers shall be capable of completely mixing the tanks as required to meet the requirements of the performance test outlined below. Each test will be conducted in the presence of the Engineer and the County. The performance requirements presented below define the minimum mixing capacity of each mixer. If additional mixing capacity is required to meet the performance test requirements, the Contractor shall provide the necessary equipment at no additional cost to the County.
2. The mixer shall be capable of homogenizing the contents of the to +/- 10%.

C. Design Criteria – Pre-Anoxic Tank

1. The low speed submersible mixer (type propeller) for the pre-anoxic tank shall be capable of handling biological activated sludge and raw wastewater with a total suspended solids concentration from 0.1 to 0.3 percent solids and a magnetite concentration from 0.1 to 0.3 percent solids, for a total mixed liquor solids concentration from 0.2 to 0.6 percent solids. The mixers shall be designed to prevent settlement in the tanks and to resuspend heavy material on the tank bottom.
2. Each mixer shall be controlled from a motor control center.
3. The submersible mixer shall be designed for the tank dimensions and water surface elevations indicated below and as shown on the Drawings

| | |
|---|---|
| **Location** | Pre-Anoxic Tank |
| **Total Number of Units** | 2 (one shelf spare) |
| **Mixer Configuration** | Submersible |
| **Maximum Propeller Speed (rpm)** | 252 |
| **Propeller Diameter (in.)** | 23 |
| **Liquid Medium** | Ballasted Mixed Liquor + Raw Wastewater |
| **Percent Biological Solids** | 0.1 – 0.3 Percent |
| **Percent Magnetite** | 0.1 – 0.3 Percent |
| **Tank Dimensions** | --- |
| **Length (Feet)** | 16 |
| **Width (Feet)** | 14 |
| **Depth (Feet)** | 26 |
| **Side Water Depth (Feet)** | 11 |
| **Motor** | --- |
| **Motor Horsepower (HP)** | 3 |
| **Motor Type** | Asynchronous Speed Type |
| **Duty** | Continuous (Min 10 Starts/Hr) |
| **Insulation** | Class H |
| **Voltage** | 460 / 3 Ph / 60 Hz |
| **Service Factor** | 1.15 |

D. Design Criteria – Influent Equalization Tank

1. The adjustable-speed submersible mixer (type propeller) for the influent equalization tank shall be capable of handling raw wastewater containing fibers and solids. The mixers shall be designed to prevent settlement in the tanks and to resuspend heavy material on the tank bottom.
2. Each mixer shall be controlled from a motor control center.
3. The submersible mixer shall be designed for the tank dimensions and water surface elevations indicated below and as shown on the Drawings

| | |
|---|---|
| **Location** | Influent Equalization Tank |
| **Total Number of Units** | 2 |
| **Mixer Configuration** | Submersible |
| **Maximum Propeller Speed (rpm)** | 180 |
| **Propeller Diameter (in.)** | 30.31 |
| **Liquid Medium** | Raw Wastewater |
| **Tank Dimensions** | --- |
| **Length (Feet)** | 62 |
| **Width** | 50 |
| **Depth (Feet)** | 11 |
| **Side Water Depth (Feet)** | 9.5 |
| **Motor** | --- |
| **Motor Horsepower (HP)** | 4 |
| **Motor Type** | Asynchronous Speed Type |
| **Duty** | Continuous (Min 10 Starts/Hr) |
| **Insulation** | Class H |
| **Voltage** | 460 / 3 Ph / 60 Hz |
| **Service Factor** | 1.15 |

## 2.2 MANUFACTURER

The equipment provided under this section shall be provided by Flygt or equal.

## 2.3 MIXER CONSTRUCTION

A. Pre-Anoxic Tank

1. Each mixer shall be of the integral-gear, close-coupled, submersible type with a maximum propeller speed of 190 rpm. All components of the mixer, including the motor and gearbox, shall provide continuous underwater operation while the mixer blades are completely submerged.
2. The mixer shall be capable of handling typical domestic or industrial raw, screened sewage with normal concentrations of rags, strings, and sand/grit. The mixer shall be designed to be easily raised, lowered, and handled for lubrication without personnel having to enter the tank. A suspension bracket and sliding console shall be an integral part of the mixer unit. The entire weight of the mixing unit shall be guided by the guide bracket, which shall handle all thrust created by the mixer. The mixer, with its appurtenances and cable, shall be capable of continuous submergence without loss of watertight integrity to the depth shown on the drawings.
3. Each mixer shall be provided with a grease chamber in the propeller hub for the shaft sealing system, a second grease chamber between the propeller hub and the gearbox and a separate oil chamber for the gearbox and the mechanical seal. Drains and inspection plugs shall be provided with positive anti-leak seals and shall be accessible from the outside.

B. Influent Equalization Tank

Each mixer shall be furnished using the following materials:

| Component | Material |
|---|---|
| Gear housing | Cast iron, ASTM 35B |
| Stator housing | Cast iron, ASTM 35B |
| Oil housing Cast iron, ASTM 35B | Cast iron, ASTM 35B |
| Shaft | Stainless steel, ASTM/AISI 431 |
| Propeller blades | Reinforced polyurethane plastic |
| Propeller hub | Cast iron, ASTM 35B |
| Lifting device | Stainless steel, ASTM 316L |
| Stand unit | Stainless steel, ASTM 316L |
| Oil, oil housing | Paraffn oil ISO VG32 |
| Oil, gear housing | Mineral oil with additives, viscosity close to ISO VG 220 |
| O-rings | Nitrile rubber |

## 2.4 MOTOR CONSTRUCTION

A. The mixer motor shall be submersible of the asynchronous speed type, housed in an air-filled, watertight chamber. The stator winding shall be insulated with moisture resistant Class F insulation, which shall resist temperatures of 315°F. The stator shall be dipped and baked three times in Class F varnish. The motor shall be designed for continuous-duty, capable of sustaining a maximum of ten evenly spaced starts per hour. The motor shall meet the requirements of IEC class N. The rotor bars and short circuit rings shall be made of aluminum. The motor shaft, delivered with the rotor as an integral part, shall be shafting steel AISI 4340. The stator housing shall be of gray cast iron AISI A48-40B.

B. Bimetallic thermal sensors, mounted in the stator windings end-turns and wired into the mixer control, shall monitor temperature. These shall supplement the external motor over load protection wired into the control panel. The thermal sensors are of the normally closed type rated at 248 º F.

C. The mixer motor shaft shall rotate on two permanently lubricated bearings. The inner and outer bearing shall be single row, deep-groove ball bearings calculated for an L-10 life of 100,000 hours at full load. The motor shall be manufactured under ISO 9001 certification.

D. The cable entry shall be an integral part of the stator casing. The cable entry shall be composed of a conical cable holder with a flange bearing against a shoulder in the stator-casing opening. The cable entry cone shall be of gray cast iron AISI A48-40B. Sealing shall be accomplished by metal-to-metal contact between machined surfaces resulting in compression of the O-ring. The cable shall be cast into the cable entry cone providing a leak-proof, torque-free seal at the cable entrance. No terminal board in the motor shall be required.

## 2.5 SEALING SYSTEM

A. Pre-Anoxic Tank

1. Each mixer shall be provided with a sealing system consisting of four seals separating the various parts. The outer seal in the propeller hub shall be a seal with a stainless steel spring, sealing propeller shaft and hub grease chamber from the mixed media, running on a stainless steel ceramic-coated exchangeable wear bushing. Mixer designs without a lip seal and grease chamber in the propeller hub will not be accepted.
2. The two inner seals on the propeller shaft shall be seals with a stainless steel spring running in a grease reservoir and isolating the propeller shaft grease chamber from the gearbox oil chamber. The fourth seal shall be a mechanical seal containing one stationary silicon carbide ring and one rotating silicon carbide part running in the oil for cooling and lubrication. It shall be mounted on

the motor shaft to isolate the gearbox oil chamber from the dry motor stator housing. Mechanical seal shall be manufactured under ISO 9001 certification.

B. Influent Equalization Tank

Each mixer shall be provided with the following sealing system:

| Inner seals | Outer seal |
|---|---|
| Lip seals:<br>Stator housing to gearbox: 2× FPM<br>Gearbox to oil housing: 1× NBR | Corrosion resistant cemented carbide (WCCR)/WCCR |

## 2.6 GEARBOX

A. The gearbox shall be a one-stage planetary reduction gear, equipped with high precision; low-loaded gears designed for infinitive live and shall have a service factor of not less than 1.5.

B. The motor shaft shall be provided with spline to attach to the gear reducer. The reduction stage shall consist of an integral toothed ring gear to which three planet wheels are mounted on the planet carriers, engaging with the sun pinion. The propeller shaft material shall be AISI 9840 high tensile carbon steel. Gear casing shall be gray cast iron AISI A48-40B.

C. All bearings incorporated in the gearbox shall have a rated life expectancy of 100,000 hours. Gearbox shall be manufactured under ISO 9001certification.

## 2.7 PROPELLERS

A. Pre-Anoxic Tank

1. The propeller shall consist of three blades welded to the side of the hub. The blades shall be fabricated of stainless steel. No propeller material other than stainless steel will be accepted.

2. It shall be based on the requirements of the tank geometry to optimize mixing and energy consumption.

3. The propeller shall be of the large diameter and large blade surface area type without a shroud ensuring soft sludge treatment and maximum propeller efficiency.

4. The blade shape shall be a non-clogging, backward curved design that starts at the flange. The propeller shall be capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications.

## 2.8 MIXER ASSEMBLY

A. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces, resulting in compression of the O-rings without secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease, or other devices. The entire mixer unit shall be assembled using stainless steel bolts quality A4 Class 80.

## 2.9 GUIDE RAIL SYSTEM

A. A guide rail system shall be used to support each mixer during operation and to guide the units during installation and lubrication/preventative maintenance inspection. The system shall consist of a bottom-bearing console, stop console, guide pipe, fixing bracket and guide holder assembly. All major components shall be fabricated of stainless steel. They shall be used in connection with a 3-inch (80x80 mm) guide pipe as recommended by the manufacturer.

B. The bottom assembly shall be bolted to the floor of the tank and provide support for the guide pipe. It shall also include a receptacle to accept the guide pipe bottom pivot. The guide pipe shall be designed to absorb the mixer thrust.

C. The mixer stop console shall be fastened to the guide pipe at a position as specified by the manufacturer, using high-strength stainless steel bolts. The stop console shall have a tapered design to receive the tapered counter part of the sliding console providing a locked position of the mixer on the stop console. The entire weight of the mixer shall rest on the stop console, minimizing stress and wear on the guide pipe during operation.

D. The mixer shall be furnished with a suspension bracket suitable for fixed or removable lifting wire installation.

E. The upper fixing bracket shall secure the system to the gangway/platform. The system shall provide the lateral support for the guide pipe allowing the possibility of the guide pipe to be positioned in any horizontal angle for flow and energy optimization. The upper guide holder assembly shall be fabricated of stainless steel and allow infinite adjustments. The guide rail assembly shall contain a stainless steel cable mesh holder to secure the electrical motor cable mesh.

## 2.10 CRANE ARM ASSMBLY

A. One portable crane arm assembly shall be provided to easily and safely raise and lower the mixer for installation. The crane assembly shall consist of a crane arm with telescopic capabilities, rotatable at 360º, a hand winch with brake for load control with stainless steel wire, a three-pronged hook and an intermediate piece.

B. The assembly shall be positioned directly into the guide pipe and shall not require any additional crane socket to be installed on the gangway/platform.

C. The three-pronged hook shall work in conjunction with the mixer's suspension bracket. The lifting system shall not require any lifting cables or chains, apart from the power cable, to be permanently attached to the mixer. Lifting systems that require permanently submerged chains or lifting cables will not be accepted.

D. The crane arm assembly shall be fabricated of stainless steel or hot dip galvanized steel.

E. The mixer manufacturer to ensure compliance shall manufacture the crane.

## 2.11 FASTENERS

A. All fasteners shall be of AISI 316 stainless steel.

## 2.12 MATERIALS

A. Major mixer components shall be gray cast iron, class 40, with smooth surfaces devoid of blow holes and other irregularities. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an epoxy coating of a minimum thickness of 0.010 inches.

B. All stainless steel components shall be electro polished or pacified to obtain maximum corrosion resistance.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Mixers shall be installed in accordance with the manufacturer's recommendations.

B. During installation the mixer manufacturer shall provide the service of qualified representative to provide the following services:
   1. Installation: Assist in installation and in coodinating electrical connections or any miscellaneous coodination.
      Provide 1 Man-day (one, 1-day trip)
   2. Start-up and performance and acceptance testing
      Provide 1 Man-day (one, 1-day trip)
   3. Operation and maintenance instructions. This instructional period shall be scheduled at least 10 days in advance with the County and take place prior to plant start-up.
      Provide 1 Man-day

**3.2 FIELD TESTS**

A. The field tests shall determine the RPM, and overall efficiency characteristics of each unit and in addition, shall demonstrate that under all conditions of operation each unit:
   1. Has not been damaged by transportation or installation.
   2. Has been properly installed.
   3. Has no mechanical defect.
   4. Is in proper alignment.
   5. Has been properly connected.
   6. Is free of overheating of any parts.
   7. Is free of all-objectionable vibration and noise.
   8. Is free of overloading of any parts.
   9. Motor and cable insulation shall be tested for moisture content or insulation defects.

   A written quality assurance record confirming the above testing/inspections shall be supplied with each pump at the time of shipment. The equipment manufacturer shall furnish the services of a factory-trained engineer for the above testing.

**END OF SECTION 44 42 42**

# SECTION 44 42 56

# CHEMICAL FEED SYSTEMS

## PART 1 GENERAL

### 1.1 SUMMARY

A. The work of this section includes, but is not limited to
   1. Chemical feed systems for:
      a. Supplemental Carbon (Micro-C 2000™, or "Micro-C")
      b. Sodium Hydroxide

B. Related work specified elsewhere
   1. DIVISION 25 Electrical
   2. DIVISION 26 Process Control Systems
   3. Section 25 50 50 Description of Operation
   4. Section 40 23 20 Pipe & Pipe Fittings
   5. Section 40 23 20 Valves and Piping Specialties
   6. Section 40 23 21 Testing Piping Systems

C. All chemical feed pumps per each chemical feed system shall be the product of one manufacturer.

D. Reference Standards
   1. ASTM D2563 Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts
   2. ASTM D2583 Indentation Harness of Plastic by Means of a Barcol Impressor
   3. ASTM D3299 Filament-Wound Glass-Fiber Reinforced Polyester Chemical-Resistant Tanks
   4. ASTM D4079 Contact-Molded Glass-Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks

E. Tank Design Safety Factors
   1. 10:1 for internal pressure for contact molding.
   2. 0.001 in/in strain limit for filament winding, 5:1 for vacuum collapse.
   3. Strength of joints shall be equal to strength of shell.

F. Factory Testing
   1. Visually inspect the tanks after fabrication to ensure Acceptance Level II requirements of ASTM D2563 are met.
   2. Perform the following during shop inspection:
      a. Check for compliance with drawing dimensions.
      b. Acetone wipe test to check surface cure; no surface tackiness is permitted.
      c. Hydro test of at least 24 hours to check for leaks.

### 1.2 SUBMITTALS

A. Shop Drawings and Product Data
   1. Submit detailed certified dimensional shop drawings and manufacturer's product data for materials and equipment, including wiring and control diagrams.
   2. Show complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners, and other details.

3. Submit calculations for determination of shell thickness, nozzle reinforcement, and all special elements of the vessel construction and support.
4. Submit certified data on the physical properties of the laminates being used to include laminate tensile modulus and flexural modulus in the hoop and axial directions, and data on the laminate makeup to include the number and thickness of layers and the layer glass content.

B. Equipment Certification
1. At the time of submitting shop drawings, submit, on the form provided, the equipment manufacturer's warranty and certification for the tank and for the chemical feed pumps attesting that the manufacturer has examined the Contract Drawings and specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.
2. Before shipment, submit certified list of tanks containing the same chemical and concentration that have been in service for a period of at least 5 years.

C. Maintenance Data and Operating Instructions
1. Submit required number of copies of an Operation and Maintenance Manual for the chemical feed pump, including a detailed description of the function of each principal component, procedures for operation, and instructions for overhaul and maintenance.
2. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

D. Maintenance Material: (Spare Parts)
1. Provide one complete set of the manufacturer's recommended spare parts for one pump of each type.
2. Package each part individually or in sets in moisture-proof containers or wrappings, clearly labeled with part name and manufacturer's part/stock number.
3. Submit, in writing, storage procedures for spare parts to ensure adequate protection after delivery.
4. Provide any special tools required for equipment maintenance.
5. Provide a list of all equipment and tools needed to maintain and calibrate equipment.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 56** AND CERTIFIES THAT THE **"CHEMICAL FEED SYSTEMS"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 56**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **"CHEMICAL FEED SYSTEMS"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must also sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

**1.3 FIELD SERVICES**

A. Provide the services of the chemical feed pump manufacturer's representative experienced in the installation and operation of the equipment supplied under this specification for not less than two 8-hour workdays on-site for installation inspection, start-up and performance testing, and instructing Owner's personnel in the operation and maintenance of the equipment.

## PART 2 PRODUCTS

### 2.1 CHEMICAL FEED SYSTEMS

A. Furnish and install a liquid Micro-C feed system complete with storage tank, feed pumps, and specified adjunct equipment all suitable for handling commercial grade and solution strength of Micro-C 2000™.

B. Furnish and install specified adjunct equipment for a sodium hydroxide feed system to be operated in the future. All equipment shall be suitable for handling commercial grade and solution strength sodium hydroxide.

### 2.2 MICRO-C STORAGE TANK

A. General Description
   1. A Micro-C storage tank shall be provided with a 1,500 gallon storage capacity.
   2. The tank shall be one piece, rotationally molded of linear polyethylene.
   3. Use appropriate materials of construction to resist and retain the process fluid without leakage or damage to the structural integrity of the tank; use the same resin throughout the construction of each tank. Provide nexus or C-veil as necessary.
   4. Tank material shall be suitable for storage of a 100% Micro-C solution having a specific gravity of 1.25.

B. Contact molded, fully gusseted nozzles of the same material as the tank.

C. Press molded accessories are not permitted in contact with the stored material.

D. All flanged nozzles to have standard 125 lb. drilling.

E. Storage Tank Construction:
   1. Vertical, non-sloping, flat bottom, closed dome top.
   2. Mount the tank indoors in concrete retaining basin as shown on the contract drawings.
   3. Mechanical Properties
      a. The minimum for the properties of the material shall be as follows based on molded parts:

| Property | ASTM | Value | Unit |
|---|---|---|---|
| Density | D1505 | 59 (0.937-0.942) | #ft$^3$(gm/cc) |
| ESCR Spec. Thickness 125 mils F-50 | D1693 | 1000 | Hrs. |
| Tensile Strength | D638 | | |
| Ultimate 2"/min. | Type IV Spec. | 2600 | PSI |
| Elongation at break | D638 | | |
| 2"/min. | Type IV Spec. | 450 | % |
| Vicat Softening Temp. | D1525 | 240 | Deg. F |
| Brittleness Temp. | D746 | -180 | Deg. F |
| Flexural Modulus | D790 | 100,000 - 110,000 | PSI |

4. The finished surface of the tank shall be free as commercially practicable from visual defect such as foreign inclusions, air bubbles, pin holes, craters, crazing and cracking that will impair the service of the tank.
5. All edges cut out; i.e., open top flanges, man-ways, shall be trimmed to have smooth edges.
6. All dimensions will be taken with the tank in its proper, usable position and unfilled. Tank dimensions will represent the exterior measurements.
    a. Outside diameter - The tolerance for the outside diameter including out of roundness, shall be ±3%.
    b. Shell wall and head thickness - The tolerance for thickness shall be ±20% of the design thickness. The total amount of an area on the low side of the tolerance shall not exceed 10 times the total area and individual area shall be not exceed 1 $ft.^2$ (.09m2) in size.
7. Provide the tank with enough individual 208V, 1 phase heating mats sized to maintain liquid contents at 60°F at 0°F ambient temperature.
8. Provide one adjustable thermostat housed in a fiberglass NEMA 4X enclosure mounted on the tanks shell wall for temperature control; thermostat will be utilized for the control of all the tank heating mats.
9. A stainless steel capillary bulb connected to the uppermost corner of the highest heat mat shall be connected o the thermostat for sensing tank temperature.
10. A second thermostat is to be provided to serve as a high limit cutout to override the temperature control thermostat when the tank temperature exceeds 175°F
11. High limit thermostat is also to be housed in a RFP enclosure mounted on the tank wall and be tied to a stainless steel capillary connected to one of the heating mats.
12. Heating mat systems which incorporate an integral bi-metal thermostat in each mat as a means for hi-temperature cutoff will be acceptable in lieu of the external hi-temperature cutout thermostat.
13. Mount thermostats and install heat mats according to the manufacturer's instructions; provide the necessary clearances around fittings to prevent hot spots; each heat mat shall be individually replaceable.
14. Ship accessory cutout blanks (except manways) with the tank for additional testing, if required. Identify the cutouts by accessory description.

F. Storage Tank Accessories
1. 24" I.D. flanged, top-mounted manway with hinged cover.
2. 24" I.D. flanged, side-mounted manway with bolted cover.
3. 4" dia. flanged type drain, capable of completely draining tank.
4. 4" dia. flanged overflow connection.
5. 3" dia. flanged nozzle in roof adjacent to top manway for level probe.
6. 4" dia. flanged vent pipe with bird screen.
7. 4" dia. flanged top fill connection.
8. 3" dia. flanged suction connection.
9. Ladder with safety cage.
10. Ladder system shall comply with OSHA requirements for fixed ladders.
11. Ladder, cage, handrail and grating shall be fiberglass as specified in Section 06 60 00.

G. Anchoring System
1. Provide each storage tank with FRP hold down lugs with stainless steel anchor bolts. A minimum of 8 lugs are required per tank.
2. The anchorage details and calculations must be submitted with the tank shop drawing.

H. Tank Nameplate

1. Mark tank with an encapsulated paper tag or stainless steel nameplate not less than 4"x6" in size and attach to the outside of the tank wall.
2. The following information shall be printed on nameplate:
    a. Name of manufacturer
    b. Capacity in gallons
    c. Manufacturer serial number
    d. Year built
    e. Maximum specific gravity
    f. Design pressure and temperature
    g. Resin

I. Tanks shall be manufactured by Justin Tanks, LLC, Chemtainer Industries, or Poly Processing Company.

## 2.3 Micro-C FEED PUMPS

A. Type: Provide three (3) electronically controlled, solenoid actuated diaphragm metering pumps suitable in all respects for handling the specified formulation of Micro-C.

B. Pump Design and Performance Criteria:
1. Provide chemical metering pumps with the following design and performance criteria:
    a. Capacity: 0.001 gph (min.) to 7.93 gph (max.)
    b. Max Discharge Pressure: 100 psig
    c. Liquid Pumped: 100% Micro-C solution
2. Chemical feed pumps shall be Model, P/N: 0M0.225R.GRA as manufactured by Watson-Marlow Pumps Group or approved equal.

C. Pump head shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 9.6mm ID.

D. Pump Head Assembly
1. Pump Track Geometry must have a minimum 96.6mm swept diameter through a minimum track angle of 120 degrees. Provide high corrosion/impact materials as specified:
    a. Track Construction: Polyphenylene sulfide (PPS)
    b. Guard Construction: Hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
    c. Rotor Construction: Polyphenylene sulfide (PPS)
2. Provide two spring–loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pump head.
3. The rotor assembly shall ensure gradual tube occlusion and compensates for tube tolerance. The twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution. The compressing rollers shall be 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm. Provide non-compressing guide rollers constructed of corrosion resistant Nylatron. Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall

automatically reengage rotor to gearbox upon one complete revolution. Mounting shall prevent slip; the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collect and central retaining screw.

E. Tubing:
1. Pump tubing shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by tube retainer clamps. The tubing shall be replaceable without the use of tools and with no disassembly of the pump head. To achieve maximum flow per revolution, pump heads with a track angle of less than 180 degrees are not acceptable.
2. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with a 64 Shore A durometer and 2.4mm wall thickness. If required for chemical compatibility, pump manufacturer shall recommend an alternate tubing material.
3. Pump shall readily accept tubing ID's of 1.6mm, 3.2mm, 4.8mm, 6.4mm. 8.0mm or 9.6mm without pump adjustment or replacement. Tubing with a wall thickness less then 2.4mm is not acceptable.
4. Supply 15-meter roll of specified tubing size.

F. High Lubricant Leak Detector:
1. Provide a float type magnetic reed switch located near the top of the pump to detect leakage of pumped product into the pump housing.
2. Supply sensor "Normally Closed" with the ability for field adjustment to "Normally Open".
3. Pump manufacturer to supply switch only. Contractor is responsible for alarm and relay to turn pump off unless otherwise specified herein.
4. Float switch shall be rated to the following maxima:

Vmax = 240VAC, Imax = 1 Amp, Pmax = 50VA

## 2.4 PUMP DRIVE SYSTEM

A. The integral electronic variable-speed gearmotor shall consist of the gearing, motor, and variable-speed controller integrally mounted together as a single configured unit with UL listing. Pumps requiring separate VFD's are not acceptable.
1. Rating: Continuous 24 hour operation, 40° C ambient.
2. Supply: 110-120V 50/60 Hz and 220-240V 50/60 Hz, 1-Phase field switchable. Supply nine-foot length mains power cord with standard 115V three-prong plug.
3. Maximum Drive Power Consumption: 135VA.
4. Enclosure: NEMA 4X or 3R
5. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including 316SS, are not acceptable.
6. Pumps must meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.
   a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions
   b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
   c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.

d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm.

7. Supply auto control features to meet the following minimum functionality requirements. Pumps not meeting this minimum functionality will not be accepted.
   a. Remote Control Inputs:
      1) Speed Control:
         a) Analog 4-20mA or 0-10VDC, with input signal trimmable and speed scalable over any part of the drive speed range.
         b) Provisions for alternative remote accessory potentiometer (if supplied by others)
      2) Start/Stop Control: Via 5V TTL, 24V industrial logic, or dry contact- Configurable command sense allowing open to equal run or open to equal stopped. Configurable to be a keypad start/stop override in Manual mode
      3) Forward/Reverse Control: Via 5V TTL, 24V industrial logic, or dry contact
      4) Auto/Man Mode Control: Via 5V TTL, 24V industrial logic, or dry contact
      5) Leak Detector Run/Stop Control
   b. Status Outputs:
      1) Four relay contacts rated for 30 VDC with maximum load of 30W, NO or NC software configurable to indicate the following:
         a) Running/Stopped status
         b) Forward/Reverse status
         c) Auto/Manual status
         d) General Alarm status
         e) Leak Detected status
      2) Speed output – Analog 0-10 VDC or 5V Square Wave Frequency output
   c. Termination: Supply screw down terminals suitable for up to 18 AWG field wire and accessible through four glanded cable entry points on the pump
8. Drive motor- brushless DC motor with integral gearbox and tachometer feedback.
   a. Speed Control Range of 2200:1 from 0.1 to 220 rpm +/- 0.1 rpm throughout the range.
   b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm
   c. Circuitry complete with temperature and load compensation and protection.
9. Mounting: Drive shall be self-supporting and shall not require anchoring.
10. Leak Detection:
    a. Factory-mount a capacitance type tube monitor directly under the pump head, which shall shut the pump down in the event of a detected leak. Capacitance sensor shall be equipped with a sensitivity adjustment, reset pushbutton, and fault indicator LED.

## 2.5 MICRO-C FEED SYSTEM ADJUNCT EQUIPMENT

A. General: Refer to the Contract Drawings for the number and connection sizes required for the chemical feed system adjunct equipment.

B. Four Functional Valve: Provide a four function valve for each pump that performs the following functions: Positive anti-syphon, back pressure, priming-aid, and pressure relief. Valve shall have a PVC

body and seat, TFE diaphragm, a 150 psi pressure rating, and an adjustable spring range of 20-100 psi. Set backpressure at 30 psi. Set relief pressure at 60 psi.

C. Mounting Shelf: Provide a mounting shelf suitable for bolting to building wall to support the pumps. Mounting shelf shall be fiberglass with stainless steel mounting bolts.

D. Provide reinforced polyethylene tubing with compression type tubing adapters for each pump. Tubing shall have a 150 psi minimum working pressure rating. Tubing adapters shall be compatible with chemicals being pumped.

E. Calibration Column: Provide one calibration column for each pump made of clear PVC with permanently marked graduation in ounces. Provide unit with a bottom female NPT threaded connection. Volume of column shall be sufficient to run pump at full capacity for two minutes minimum.

F. Connector: Provide connector with a quick disconnect coupling, cap, and chain all of stainless steel construction. The connector shall be as manufactured by OPW, Division of Dover Corporation, Cincinnati, Ohio, or equal.

G. Provide a pressure gauge for each pump with a range from 0-80 psi.

H. Provide a pulsation dampener for each pump.

## 2.6 SODIUM HYDROXIDE FEED SYSTEM ADJUNCT EQUIPMENT

A. General: Refer to the Contract Drawings for the number and connection sizes required for the chemical feed system adjunct equipment.

B. Four Functional Valve: Provide a four function valve for each future pump that performs the following functions: Positive anti-syphon, back pressure, priming-aid, and pressure relief. Valve shall have a PVC body and seat, TFE diaphragm, a 150 psi pressure rating, and an adjustable spring range of 20-100 psi. Set backpressure at 30 psi. Set relief pressure at 60 psi.

C. Mounting Shelf: Provide a mounting shelf suitable for bolting to building wall to support the pumps. Mounting shelf shall be fiberglass with stainless steel mounting bolts.

D. Provide reinforced polyethylene tubing with compression type tubing adapters for each future pump. Tubing shall have a 150 psi minimum working pressure rating. Tubing adapters shall be compatible with chemicals being pumped.

E. Calibration Column: Provide one calibration column made of clear PVC with permanently marked graduation in ounces. Provide unit with a bottom female NPT threaded connection. Volume of column shall be sufficient to run future pump at full capacity for two minutes minimum.

F. Provide a pressure gauge for each future pump with a range from 0-80 psi.

G. Provide a pulsation dampener for each future pump.

H. Provide a movable containment sock for the Sodium Hydroxide Tote Storage Area as shown on the drawings. Sock shall be suitable for absorbing 30% sodium hydroxide.

## 2.7 CONTROLS

A. The controls for the Chemical Feed Pumps will be furnished by the Process Control System Supplier. Refer to Section 25 50 50 *Description of Operation* for a description of the controls.

## PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install chemical feed equipment as indicated on the Contract Drawings and in accordance with the manufacturer's instructions and approved shop drawings.

B. Provide and connect piping, accessories, power and control conduit and wiring as required to ensure a complete operable system as intended.

C. Install a minimum of two layers of 30 lb. roofing felt beneath the Micro-C storage tank in accordance with the manufacturer's requirements.

D. Obtain and provide the Owner with an Installation Certificate from the equipment manufacturer's representative attesting that the equipment has been properly installed and is ready for start-up and performance testing.

## 3.2 START-UP AND PERFORMANCE TESTING

A. Pump Calibration
   1. Determine the calibration curves for each chemical feed pumping unit by plotting capacity versus four different stroke settings between 0 and 100% at 25% increments.
   2. Compute the capacities by measuring the time to empty a calibration column filled with water.

B. Valve Settings: Demonstrate that each chemical feed pump's backpressure and pressure relief valves are properly set.

C. Operate each system on clear water for a continuous period of four hours, under the supervision of the manufacturer's representative and in the presence of the Engineer; demonstrate all system control functions and alarms.

D. Hydrostatically test the system piping for leaks at 100 psig according to Section 40 23 21, *Testing Piping Systems*.

E. Tank Testing
   1. Hydrostatically test the Micro-C storage tank by filling with water to the overflow pipe level.
   2. Check for proper operation of the liquid level indicator.
   3. The water shall be left in the tank at the full level for a minimum of 48 hours.

F. Micro-C Piping
   1. 1/2" PE 200 psi tubing encased within 2" schedule 80 PVC conduit pipe. A spare ¼" nylon pull rope is to be included in each conduit pipe.

2. Feed points include SBR No's 1 & 2.
3. The Micro-C suction header containment piping shall be 4" schedule 80 PVC, FRP or Stainless Steel.

G. Sodium Hydroxide Piping
1. 1/2" PE 200 psi tubing encased within 2" schedule 80 PVC conduit pipe. A spare ¼" nylon pull rope is to be included in each conduit pipe.
2. Feed point is the Influent Pump Station as shown on the plans.

## 3.3 EQUIPMENT ACCEPTANCE

A. Adjust, repair, modify or replace any components of the system which fail to perform as specified and rerun the tests.

B. System modifications will be subject to approval by the Engineer.

C. Make final adjustments to the equipment under the direction of the manufacturer's representative and to the satisfaction of the Engineer.

**END OF SECTION 44 42 56**

# SECTION 44 42 61

# SEQUENCING BATCH REACTOR SYSTEM

## PART 1 GENERAL

### 1.1 SUMMARY

A. Furnish all labor, miscellaneous equipment and incidentals required and install complete, ready for operation and field-test two (2) upgraded Sequencing Batch Reactors (SBRs) and appurtenances, as shown on the Drawings and as specified herein. The SBR systems will be configured to treat screened raw wastewater to meet enhanced nutrient removal (ENR) effluent standards through a true batch process. The system operates using ballasted activated sludge technology with the BioMag system. The System shall have the size and configuration of tanks and equipment shown on the drawings to treat the loadings and achieve the effluent criteria specified herein.

B. The system improvements shall consist of diffused aeration using new retrievable fine-bubble diffusers, blowers, floating effluent decanters, automatic influent valves, and automatic decant valves. The upgraded SBRs shall be an AquaSBR® system as manufactured by Aqua-Aerobic Systems, Inc. or an approved equal.

C. The work of this section includes, but is not limited to:
1. Positive Displacement Blowers and Motor Assemblies.
    a. Intake and Discharge Silencers and Intake Filter
    b. Drive and guard
    c. Blower control panels
    d. Check and Blower Isolation Valves
    e. Pressure Gauges
    f. Expansion Joints
    g. Pressure relief valves
    h. Acoustical and weatherproof enclosures
2. Retrievable Fine-Bubble Diffusers
    a. Diffuser Racks
    b. Track/beam Assembly
    c. Diffuser Hoist Assembly
    d. Tank Connection
    e. Manifold
    f. Vertical Air Column and Threaded Flange
3. Control valves
    a. Influent plug valves (2)
    b. Decant flow control valves (2)
4. Decanter Assembly
    a. Weir with Weir Actuator
    b. Float
    c. Decanter Discharge Pipe
5. Instrumentation
    a. DO sensor
    b. pH meter
    c. Level sensor

C. Intended Purpose: The intended purpose of the SBR system is to upgrade the level of treatment achieved in the SBRs at the Smithsburg WWTP along with expanding the treatment capacity from 0.33 mgd to 0.45 mgd. The new equipment specified below shall allow the SBRs to obtain treatment goals specified in the SBR design criteria.

D. Related Work Specified Elsewhere
1. Division 9 Finishes
2. Division 40 – Pipe, Pipe Fittings, and Valves
3. Division 25 - Integrated Automation
4. Division 26 – Electrical
5. Division 44 SBR Control Panel Specification

**1.2 SUBMITTALS**

A. Submittal sheets are to be 8-1/2 x 11 inches, or if larger, to be folded to 8-1/2 x 11 inches so that the title block is clearly visible without unfolding. Drawings are to be similarly folded and inserted in a soft cover binder.

B. Shop Drawing Submittals shall include at least the following:
1. Certified shop and erection drawings showing all important details of construction dimensions, anchor bolt locations, and field connections.
2. Descriptive literature, bulletins, and catalogs of the equipment, including lubrication points.
3. Installation, operation, and start-up procedures including lubrication requirements.
4. Complete motor data.
5. Total weight of the equipment including the weight of the single largest item.
6. A complete bill of materials for all equipment with the O&M manual. No samples will be required. The O&M Manuals will be provided prior to shipment, and not with the submittals.
7. A list of spare parts that are supplied with the project.

C. Operation and Maintenance Manuals
1. Submit operation and maintenance manuals for the equipment in compliance with the Contract documents, 30 days prior to shipment. Manuals shall include:
   a. Name, address, and telephone number of the nearest competent service representative who can furnish parts and technical service.
   b. Descriptive literature, including illustrations, covering the operational features of the equipment, specific for the particular installation, with all inapplicable information omitted or marked out.
   c. Operating, maintenance and trouble shooting information.
   d. Complete maintenance parts list.
   e. Complete connection, interconnecting and assembly diagrams.
   f. Approved Shop Drawings.

D. Equipment Certification

At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification for the Sequencing Batch Reactor System attesting that the manufacturer has examined the Contract Drawings and Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

E. Factory Test Report for blowers: Certified test results shall be provided. The test shall be conducted in

accordance with an ISO 1217 test. The factory slip RPM shall be utilized to record and calculate data. A certified report shall be submitted to the engineer prior to shipment. The following shall be provided:

1. RPM
2. Capacity – scfm and icfm
3. Discharge pressure
4. dB(A) noise pressure level
5. Maximum gear tip speed and rotor tip speed (fpm)
6. HP required at rated capacity and pressure
7. Rated maximum pressure rise of blowers
8. Vibration and balancing certification

F. Shop Drawings - blowers: Submit an integrated shop drawing for the blower system. All mechanical and electrical equipment and components specified herein must be included to be considered a complete shop drawing:
   1. Product Data: For each mechanical and electrical product include manufacturer's descriptive literature; product specifications; published details; technical bulletins; performance and capacity rating curves, charts and schedules; catalog data sheets.
   2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross sections of system equipment and sub-assemblies.
   3. Layout Drawing: Submit completely dimensioned drawing of a packaged blower assembly that includes foundation details, anchor bolt size and patterns, supports, installation notes, and other pertinent setting details.
   4. Product List: Provide a list of equipment and components on all drawings with each product identified by legend reference. Include product name, manufacturer, and model number.
   5. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.
   6. Bill of Materials: Provide a complete Bill of Materials list for the blower equipment and components, including the motor. Each part shall be identified by legend reference. Include part name, materials of construction, manufacturer, and part number.

G. Provide factory certifications that positive displacement, rotary lobe blowers and motors have been dynamically balanced to the standards specified herein.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 61** AND CERTIFIES THAT THE **"SEQUENCING BATCH REACTOR SYSTEM"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 61**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **"SEQUENCING BATCH REACTOR SYSTEM"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

**1.3 QUALITY ASSURANCE**

A. The Contractor shall assign full responsibility for the functional operation of all System components to a Single Source Supplier. This Single Source 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 System along with all other equipment and accessories as specified herein.

The System shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater treatment systems. The manufacturer's experience shall include a minimum of ten installations where equipment of similar size and design has been in operation successfully in a similar process for a minimum of five years. As a minimum, the supplier shall be the manufacturer of the following components: decanters, retrievable diffusers, diffusers, and controls.

B. The installation of the equipment furnished by the manufacturer shall be the responsibility of the Contractor in accordance with all requirements of the contract documents.

C. The valves, equipment, materials of construction and controls specified under this section are to be used in the System and supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents for the remainder of the Contract.

D. The manufacturer of the System shall be completely responsible for the proper design of their system, including but not limited to; diffused aeration equipment, decanters, and controls. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

E. SBR Design Criteria:

| | | |
|---|---|---|
| Average Daily Flow | 0.45 | MGD |
| Max Daily Flow | 0.6 | MGD |
| Peak Hydraulic Flow | 2.7 | MGD |

| Design Loadings | | Influent | | Effluent |
|---|---|---|---|---|
| BOD | 360 | mg/l | 10 | mg/l |
| TSS | 375 | mg/l | 16 | mg/l |
| TKN | 97 | mg/l | -- | mg/l |
| $NH_3$-N (May-Oct) | -- | mg/l | 0.5 | mg/l |
| $NH_3$-N (Nov-Apr) | -- | mg/l | 1.0 | mg/l |
| TN | -- | mg/l | 30.6* | mg/l |
| Phosphorus | 13.3 | mg/l | 0.8 | mg/l |

*Excludes pre-anoxic denitrification

| | | |
|---|---|---|
| Wastewater Temperature | | |
| Minimum | 46 | °F |
| Maximum | 68 | °F |
| Ambient Temperature | | |
| Minimum | **30** | °F |
| Maximum | **85** | °F |
| Jobsite Elevation | 700 | Ft MSL |
| Alpha | 0.53 | |
| Beta | 0.95 | |
| MLSS at LWL | 8,000 | mg/l |
| Maximum Cycles at Max. Daily Flow | | |
| Oxygen Requirements | | |
| | 1.25 | lbs O2/lb $BOD_5$ applied |
| | 4.6 | lbs O2/lb TKN applied |
| Minimum Hourly AOR | 160.2 | lbs $O_2$/hr |
| Minimum Aeration Time | 2.3 | hrs/cycle at maximum daily flow |
| Minimum Mixing Time | 4 | hrs/cycle at maximum daily flow |
| Minimum Settling Time | 0.67 | hrs/cycle at maximum daily flow |

The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.

| The existing SBR basins will be used as summarized below. | 2 | |
|---|---|---|
| Basin Quantity | | |
| Diameter | 57 | feet |
| Minimum Operating Level | 12.0 | feet |
| Maximum Operating Level | 15.5 | feet |
| Top of Wall | 17.5 | feet |
| Centerline of discharge | 5.2 | feet below LWL |

F. Blower Performance Criteria

| | | |
|---|---|---|
| Blower Quantity | 3 | New (in addition to 3 existing) |

| | | |
|---|---|---|
| New Blower Motor Size | 75 | HP |
| New Blower Airflow rate | 1,440 | SCFM per blower |
| Maximum discharge gauge pressure | 8.28 | PSIG |
| Inlet Configuration | Combination filter/silencer | |
| Enclosure | powder coated galvanized steel acoustic hood with oil drip pan | |
| Discharge Isolation Valve | | |
| Diameter | **6** | inches |
| Seat material | EPDM | |

Manufacturer or Packager Qualifications: Supplier shall have experience in providing similar equipment, and shall show evidence of satisfactorily operating installations in the eastern region of the United States.

The blower(s) shall be covered by a warranty for 24 months from date of commissioning, or a maximum of 30 months from date of shipment.

The blower package and all components, including sound enclosure, must be provided by the manufacturer of the blower stage, for single source reliability.

The existing blowers shall provide 380 SCFM airflow capacity per blower.

G. Retrievable Fine-Bubble Diffusers Performance Criteria

The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the contract drawings.

| | | |
|---|---|---|
| Airflow per basin | 1,820 | SCFM |
| Assembly quantity | 4 | Per basin (plus 2 existing) |
| Diffuser Rack Size | 25 | Duplex tubes |
| Materials of Construction | | |
| Manifold | 304 | Stainless steel |
| Vertical Air Column | Galvanized steel | |
| Threaded Flange | Galvanized steel | |
| Quick Disconnect Adapter | SS | |
| Track/beam Assembly | Galvanized steel | |
| Diffuser Hoist Assembly | Galvanized steel | |
| Valve Seat | EPDM | |
| Tank Connection | 304 SS adhesive anchors | |

H. Control Valve Performance Criteria

The contractor shall furnish electrically operated flanged plug valve(s) for each basin to control the influent and effluent flow. Actuated valves shall be tested to SBR system manufacturer test protocol prior to shipment. Testing shall consist of the following:

- Project and nameplate data verification per assembly documentation
- Limit switch and torque switch setup and cycle test
- Hydrostatic test (two pressurization cycles) for all plug and butterfly valves

| | | |
|---|---|---|
| Influent Plug Valve | | |
| Valve quantity | 1 | Per basin |
| Valve Size | 12 | inch |
| Valve Model | Milliken 601 | |
| Actuator | Auma | |
| Actuator Power | Three | Phase |
| Actuator Type | Open/Close | Service |
| Compartment Heater | Yes | |
| | | |
| Decant Valve | | |
| Valve quantity | 1 | Per basin |
| Valve Size | 10 | inch |
| Valve Model | Milliken Fig. 511A | |
| Actuator | Auma | |
| Actuator Power | Single | Phase |
| Actuator Type | Open/Close | Service |
| Compartment Heater | Yes | |

I. Decanter Assembly Performance Criteria

Furnish floating decanter(s) and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless steel movable weir assembly, and an electric motor-driven actuator to open and close the weir.

| | | |
|---|---|---|
| Quantity | 1 | per basin |
| Unit size | 8x7 | |
| Performance Requirements | | |
| Maximum allowable water level (HWL) | 14.2 | ft |
| Minimum allowable water level (LWL) | 9 | ft |
| Decant pipe centerline | 2.2 | ft below LWL |
| Decant rate, as average from HWL to LWL | 1,852 | gpm |
| | | |
| Weir Actuator | | |
| Linear Weir Actuator | Single | phase |
| Weir Actuator Closing Force | 1,500 | lbs |
| Power Section Material | Painted | steel |
| Band Clamp Heater | Aluminum | |
| Junction Box Rating | NEMA 4X | |
| Power Cable(s) Required | #14 AWG | ten-conductor |
| | | |
| Weir | | |
| Shape | Circular | |
| Material | 304 | SS |
| | | |
| Decanter Float | | |
| Reserve Buoyancy | 875 | lbs |
| | | |
| Discharge Line | | |
| Type | Pipe | |

| | | |
|---|---|---|
| Diameter | 10 | inches |
| Mooring System | | |
| Pylon Quantity | 1 | Per unit |
| Pylon Diameter | 4 | inch |
| Support Quantity | 3 | Per unit |
| Support Diameter | 3 | inch |
| Pylon/Support Material | Galvanized steel | |
| Base Plate Material | Galvanized steel | |
| Floor Connection | 304 SS adhesive anchors | |
| Mooring Frame Material | Galvanized steel | |
| Discharge Pipe | | |
| Elbow Material | 304 | SS |
| Pipe Material | 304 | SS |
| Flex Joint/Hinge Material | 304L | SS |
| Flex Joint rating | 50,000 | cycles, minimum |

Each decanter shall be capable of withdrawing decant fluid from 4-6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2-6 inches. The weir shall permit liquid to enter the decanter from the entire 360 degrees without obstruction.

## 1.4 FIELD SERVICES

A. General: Provide the services of a qualified factory certified representative for the required man-days as specified hereunder. A man-day is defined as eight (8), on-site, working hours.

B. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 4 trip(s) and 10eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

C. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

## 1.5 TESTING

A. A certified factory slip test report from shall be supplied for each blower.

B. Each blower shall be tested in accordance with ISO 1217 testing procedures for positive displacement blowers. The results of this test shall be certified by a Registered Professional Engineer and submitted to the engineer prior to shipment.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.

B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

C. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.

**1.7 MAINTENANCE**

A. Spare Parts

Furnish the following spare parts:

| Component | Quantity |
|---|---|
| Decanter linear actuator with capacitor. | 1 |
| Decanter limit switch with arm. | 1 |
| Input card. | 1 |
| Output card. | 1 |
| Membrane Kits | 50 |
| Crimping Tool | 1 |
| Blower Inlet Filters | 2 per blower |
| Blower V-belts | 1 per blower |

Spare parts shall be properly bound and labeled for easy identification without opening the packaging.

In addition, new belts and sheaves will be provided for the existing three (3) 25 HP blowers to decrease the air flowrate to 380 SCFM/blower.

**PART 2 PRODUCTS**

**2.1 POSITIVE DISPLACEMENT BLOWERS**

A. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 15 years and a Mean Time Between Overhauls of 5 years of continuous operation.

B. No special foundations shall be required. The blower packages will be installed directly on a concrete slab without grouting the base frame. There shall be only 4 easily accessible anchor points.

C. The blower casing shall be of one-piece construction, with separate sideplates that are bolted and pinned to the housing. Materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions. Minimum blower casing pressure rating shall be 36 psig. Inlet and outlet shall be flanged connections. The casing shall incorporate a proven means of pulsation cancellation. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall not exceed 0.5"/ sec RMS when operating at the specified maximum operating pressure and speed in the actual blower package.

D. Each blower stage shall be factory tested in accordance with ISO 1217 performance test to verify flow and brake horsepower at blower maximum conditions. A slip test shall not be acceptable. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of

the machine.

E. Each impeller shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed. The impellers shall be of the straight, three-lobe type, and shall operate without rubbing or liquid seals or lubrication. Rotor/shaft shall be drop forged in one single piece of AISI 1043 or equivalent. Cast, hollow rotors shall be capped, dust tight. Open rotors are not acceptable. The impellers shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G6.3.

F. Each impeller/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the impeller/shaft in the unit. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.

G. The impellers shall be timed by a pair of single helical AGMA 12 quality gears with hardened and ground teeth; minimum AGMA service factor of 1.70. Gears shall be dynamically balanced to ISO 1940/ANSI S2.19 G1.0, mounted on the shafts with a tapered interference fit, and secured by a locknut.

H. Seal shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine. Four rotary piston ring shaft seals, an oil slinger and an O-ring seal shall be provided at the point where the shaft passes through the sideplates. Further provision shall be made to vent the impeller side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream.

I. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall be not acceptable.

J. A recessed oil sight glass must be provided on each oil sump. Protruding sight glasses are not acceptable.

K. Painting shall be per supplier's standard meeting the following criteria. Excepted for machined sealing and machined mounting surfaces, the package shall be painted dark blue. Aluminum, stainless steel, and brass shall not be painted. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70□m. Surface preparation SSPC10 or better. Sound enclosure shall be powder-coated polyester base total dry film thickness 80 micro-m. Galvanized components may only be painted with appropriate surface preparation.
   1. The contractor shall furnish three phase rotary lobe compressors with premium efficient, T.E.F.C., Class F insulation, Teco, Siemens, or equal motor. The blowers shall be manifolded for individual and/or combined operation as shown on the contract drawings.
   2. Blowers to be Aerzen D52S or approved equal.
   3. Each motor shall include a single phase normally closed motor winding thermostat.
   4. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.
   5. Equipment shall include a blower, electric motor, belts and sheaves, inlet package, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

## 2.2 BLOWER PACKAGE ACCESSORIES

A. Each package shall be supplied with one combination inlet filter silencer. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4. The inlet filter silencer shall be mounted directly to the inlet flange of the blower. The silencer portion shall be located upstream of the inlet filter. Filter and silencer performance losses shall be included in the blower performance calculation.

B. Each package shall be supplied with one combination base frame / discharge silencer.
   1. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous or absorption materials of any kind. Fabricated of a single shell of pressure vessel quality steel with continuous welds, the silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum blower operating pressure. The silencer shall have a machined inlet connection where the discharge flange of the blower stage bolts directly to, with no intermediary pieces. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation.
   2. The base frame is to be constructed from welded carbon steel or cast iron that shall be designed to maintain alignment of the blower internal components and the drive during operation. It shall be designed to resist distortion while being installed on vibration isolating mounts. The blower manufacturer shall supply a stainless steel grounding lug fully welded to the base.

C. Each package shall be connected to the plant piping via flexible connector(s) located downstream of the discharge silencer and upstream of the inlet. They shall prevent the transmission of noise and vibrations from the blower package into the piping. The flexible connectors shall be Unaflex "Supreme" Style 189, with a standard ANSI flange discharge connection.

D. Each package shall be supplied with a WEG manufactured TEFC motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 1740 RPM. All frame sizes shall be NEMA standard suitable for overhung belt drive, and with the conduit box location on top of the motor. IEC frame motors are not allowed. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating bHp. The motor shall have a 1.15 service factor. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor. Should an unloading valve be required, the blower manufacturer shall supply it. It shall be an automatic type mechanically operated valve requiring no electrical connections mounted upstream of the check valve. The blower motors shall be rated for inverter duty, suitable for operation on a VFD.

E. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp. Belt tensioning shall be automatic without the use of any devices or interaction on the part of the operator. Neither slide rails nor load-adjusting springs shall be used. Sheaves shall be dynamically balanced.

F. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%. Blower manufacture shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations form the blower package being transmitted to the base or the piping.

G. The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement. Guard material shall be perforated carbon steel.

H. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating, and shall be sized to pass 100% of the design flow. The valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED. The pressure relief valve shall also be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure. The relief valve exhaust shall be directed away from the inlet of the blower to prevent recycling of the heated air.

I. Each package shall be supplied with one check valve that shall be installed on the discharge line. It shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal. The valve shall be removable without disturbing the piping. The valve shall be manufactured by Aerzen or approved equal. Pressure losses produced by the check valve shall be included in the blower performance calculation.

J. Each package shall be supplied with the following instrumentation:
   1. One inlet vacuum gauge, Wika model 611.10 or approved equal with 2½ ” dial and scale from 0 to –25 inches of water column with accuracy of +/- 1.6% of FSV. Gauge to function as a filter maintenance indicator.
   2. One discharge pressure gauge, Wika model 213.40 or approved equal with 2½ ” dial and scale from 0 to 23 psig. The pressure gauge shall have a gold-plated forged brass case.
   3. One discharge temperature gauge / switch, Wika type SC15608S205-0 or approved equal with 2½ ” dial and scale from 32°F to 572°F. NEMA 4 enclosure, 5A @ 250volt, SA 28 SPDT microswitch, and UL &CSA approved.

K. Each blower shall receive it initial oil filling at the factory. Oil to be fully synthetic Mobil SHC 629. For continuous discharge temperatures greater than 248°F, Mobil SHC 630.

L. Each package shall be supplied with a sound enclosure covering the entire blower package. The enclosure shall be designed to be able to install them side-by-side with all maintenance done from the front or back of the package. Details are as follows:
   1. Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color. Sound enclosure acoustic material shall comply with UL 94 - HF1 for fire-retardant, self-extinguishing, non-dripping materials.
   2. The enclosure and the blower package must be both mounted on a skid / oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.
   3. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.
   4. Quick release panels, each less than 50 lb (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package components.
   5. A high efficiency blower shaft driven ventilation fan shall provide ventilation and cooling integral to the sound enclosure. Cooling fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD.
   6. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
   7. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines to be hydraulic hose with fittings. No plastic tubing with compression fittings are allowed.

M. Each blower shall be furnished with an inlet screen/silencer to be located on entrance to the inlet suction pipe. The inlet screen/silencer shall be suitable for outdoor use.

N. Each package shall include an Aerzen AERtronic Digital Controller panel with the following features:

1. Intuitive TFT color touch screen display
2. Display, monitoring, alarm and shutdown of inlet pressure, discharge pressure, discharge temperature, enclosure cooling fan thermal overload, main drive motor thermal overload, oil temperature and oil pressure (if applicable)
3. Display run hours
4. Log errors and first out indication
5. Track and log maintenance
6. E-Stop button mounted on front of blower enclosure
7. Operation of enclosure cooling fan motor starter and oil demister
8. Control Enclosure:
    a. NEMA 12 for indoor installation
    b. NEMA 4X for outdoor installation
    c. Factory installed, integral to sound enclosure
9. Control Supply Power:
    a. 460 VAC, 10 amp feed with 24 VDC transformer
10. Monitoring Sensors (minimum):
    a. Inlet Pressure Transducer
    b. Discharge Pressure Transducer
    c. PT 1,000 Discharge Temperature RTD
    d. PT 1,000 Oil Temperature RTD

## 2.3 BLOWER CONTROLS

A. To be provided as part of the SBR Control System. See SBR Control Panel Specification.

## 2.4 RETRIEVABLE FINE-BUBBLE DIFFUSERS

A. Contractor shall Furnish retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible air line, isolation valve, and lifting mechanism. Duplex diffuser tubes total that specified herein shall be provided for each diffuser rack. The 4" diffuser manifold weldment shall be constructed of stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

B. Air diffuser assemblies shall be of the tubular, non-clog, fine bubble type with a flexible perforated air release membrane. Disc and panel diffuser designs are not acceptable. The diffuser membrane shall be constructed from EPDM rubber and be suitable for continuous or intermittent aeration. Each membrane shall be held in place by two 304 stainless steel band clamps. The membrane shall include UV inhibitor and compounds designed for resistance to chemical attack, weathering, fatigue, and aging. The diffuser assemblies shall have double backflow prevention to prevent liquid from passing into the aeration header. Backflow prevention shall consist of self sealing slits and membrane clamping over the circumference of the diffuser support pipe. The membrane exterior surface shall be

smooth as to inhibit biological film growth. The membrane shall inflate during aeration and deflate when the airflow is discontinued, further restricting biological film growth. The membrane shall be cleanable in place with water from a high pressure wash. Each diffuser membrane shall be supported over its' full length and circumference by a support tube. Tube diffuser shall be of non-buoyant design. Diffusers which are of buoyant design are not acceptable.

C. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, and a threaded flange, elbow and quick disconnect adapters. All air distribution piping, gaskets, and hardware beyond the threaded flange shall be supplied by the installing contractor. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

D. Each assembly shall include a diffuser hoist assembly with base socket to receive a portable electric winch. A total of one portable electric winch shall be provided for the diffuser assemblies. The winch mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a single phase, electrical supply rated for 12.6 full load amps. The winch shall be provided with a total of 8 feet of electrical cable. Supply of electrical power supply, wiring and junction box for winch shall be the responsibility of the installing contractor.

E. Each diffuser assembly shall include a 3" diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor. Valve gaskets and hardware are to be provided by the installing contractor.

F. Valve shall be a butterfly valve with cast iron body, seat as specified herein, disk and one piece stainless steel shaft.

G. Anchoring the diffuser assemblies to the basin shall be the responsibility of the installing contractor.
   1. New sleeve kits shall be provided for replacement of all existing diffusers in the SBR.

## 2.5 CONTROL VALVES

A. Influent control valves shall be a 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, coated non-lubricated ductile or cast iron plug with 80 % port opening, assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, 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). Field wiring and junction/box disconnect shall be provided by the installing contractor.

B. Decant flow control valve shall be an AWWA C-504 Class 150B electrically operated butterfly valve(s) with ANSI Class 125# flanged end ASTM ductile or cast iron body and disk with a 316 stainless steel edge, EPDM seat, 304 stainless steel shaft assembled and tested with an electric actuator. Valve actuator shall include motor winding protection, 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). Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

## 2.6 DECANTER ASSEMBLY

A. The weir shall include vortex control baffles permanently affixed to the weir. The weir shall be

attached to the actuator through a removable single shaft or linkage which shall also function as the torque restraint.

B. Each unit shall be equipped with a modular float constructed of fiberglass filled with closed cell polyurethane foam having a minimum 2.0 lbs./ft3 density. Float shall be completely sealed to prevent the foam from being in contact with the external environment. Float shall have adequate reserve buoyancy as specified within this section to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

**2.7 DECANTER DISCHARGE PIPE**

A. Each decanter shall include a stainless steel elbow with schedule 10 stainless steel discharge pipe as specified above. The installing contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.

B. Each decanter shall include two stainless steel flex joints sized at the same diameter as the discharge pipe. Flex joints shall be constructed of stainless steel flanges and 321 stainless steel bellows. Flex joints shall utilize heavy duty stainless steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a minimum number of cycles as specified above per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be fully crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.

C. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing contractor.

**2.8 DECANTER RESTRAINED MOORING SYSTEM**

A. The contractor shall furnish as part of the decanter assembly a mooring frame, which shall permit the assembly to move up and down following the change in liquid level while restrained within the vertical pylons.

B. Each decanter shall be moored with a restrained mooring system consisting of vertical pylon(s) with base plate and/or supports as specified above. Each pylon/support with base plate shall be attached to the basin floor and filled with concrete by the installing contractor.

C. Mooring post supports, if specified within this section shall be provided for attachment to the basin wall by the installing contractor.

**2.9 INSTRUMENTATION**

A. The contractor shall furnish one submersible pressure transducer unit per basin constructed of 304 stainless steel. Transducer shall be KPSI model 700 or approved equal. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire.

B. Transducers shall be suspended on a removable mounting pipe assembly. Pipe, supports and anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of

the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

C. All materials used for mounting and tank connection shall be 304 stainless steel.

D. Field attachment of the pressure transducer mounting brackets to the tank shall be the responsibility of the installing contractor.

E. The contractor shall furnish one Hach LDO or approved equal dissolved oxygen probe and one Hach pH probe or approved equal pH probe per basin. Probes shall be suspended on a removable mounting pipe assembly. Stainless steel pipe, stainless supports and stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

F. The contractor shall furnish one Hach model SC4500 or approved equal controller per basin that will communicate with the main PLC via 4-20 mA signals. The controller will have a NEMA 4X enclosure with corrosion-resistant finish and shall be AC powered from a 100-230VAC, power source. Each probe module shall include a sun shield.

## PART 3 EXECUTION

### 3.1 INSTALLATION - BLOWER

A. Install blower and motor assembly, piping, silencers and appurtenances as indicated on the Contact Drawings and in accordance with the manufacturer's instructions.

B. All piping will be supported so as to preclude the possibility of exerting undue forces and moments on the blower flanges. Suitable flexible connectors will be furnished to isolate the blower from the piping system. Each blower unit shall be mounted on a flat and level concrete pad suitable for supporting the dead weight of the unit.

C. Mount intake and discharge pressure gauges where indicated; provide isolation petcock and 1/4" stainless steel tubing from air piping to gauges.

D. Provide and connect piping, accessories and power as required to ensure a complete operable system. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer's representative

E. Obtain and provide the Owner with an Installation Certificate from the equipment manufacturer's representative attesting that the equipment has been properly installed and is ready for start-up and performance testing.

### 3.2 TEST PREPARATION - BLOWER

Check correct rotation of blower motor. Ensure proper blower and motor lubrication.

### 3.3 BLOWER PERFORMANCE TEST

A. Test each blower unit under the direction of the manufacturer's representative for a period of three continuous hours operation of each blower with readings taken and recorded at 30-minute intervals at

the maximum water level to demonstrate correct alignment, smooth operation, freedom from vibration, noise and overheating.

B. Take the following data using metering devices to show proof of successfully meeting performance requirements:
   1. Blower and motor RPM; motor Bhp.
   2. Discharge air pressure.

C. In the event a component fails to perform as specified or is proven defective during operation, correct all deficiencies and rerun the performance test; equipment modifications will be subject to the approval of the Engineer.

**3.4 FACTORY TEST – ALL EQUIPMENT**

Each system component shall be factory tested to ensure satisfactory operation.

**3.5 INSTALLATION – ALL EQUIPMENT**

The SBR equipment shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.

**3.6 PERFORMANCE TESTING**

A. Manufacturer's representative shall attest the unit has been properly installed and is ready for testing and operation.

B. The SBR Equipment shall perform to produce a result in compliance with these specifications; modifications may be made to the equipment to produce the specified result providing the modification does not later alter the basic design or operating characteristics.

C. Testing will consist of the operator performing standard tests required by the governing regulatory agency during the performance test period. The manufacturer's field service representative will assist on the phone during the entire time as needed.

D. The performance test shall be executed using plant influent wastewater after the plant screening and other upstream processes have stabilized and the plant is performing according to the design specified operating requirements. The SBR effluent shall be as given in section 1.3.E of this protocol at the average daily flow listed.

E. Testing will be done on the entire SBR system. The system will be tested according to the governing regulatory agency's testing requirements. The actual flow at the time of testing will be monitored.

F. Testing shall be done by the local certified lab according to the latest edition of Standard Methods for the Examination of Water and Wastewater using personnel and equipment provided by the lab. The Owner shall furnish all labor, materials, power, water, equipment, lab services, instrumentation, and any other equipment and services necessary for conducting the field performance testing.

G. All influent and effluent data shall be compiled onto an Excel spreadsheet. Data shall be charted to clearly show performance compliance.

H. Influent flow rates shall be measured using an influent flow meter (provided and installed by the

Installing Contractor) and shall be compiled onto an Excel spreadsheet.

I. The Manufacturer shall receive the test data from the Owner showing the actual influent and effluent quality and flow rates and shall conclude whether the SBR has met the specified level of performance.

J. Should the any component fail to meet the performance criteria after modification, the component shall be removed and replaced with one that can meet the performance standard, at no additional cost to the Owner.

**3.7 FIELD QUALITY CONTROL**

Supplier shall provide the services of a factory-trained representative to check the installation and to start-up each system component. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. The representative shall inspect the final installation and supervise a start-up test of the equipment.

**END OF SECTION 44 42 36**

# SECTION 44 42 62

# SBR CONTROL PANEL

## PART 1 GENERAL

### 1.1 SUMMARY

A. Work Included/Intended Purpose:
   1. Furnish and install a new SBR Control Panel to replace the existing SBR Control Panel located in the Control Building. The new control panel shall control the SBR process and related treatment plant equipment.
   2. The control panel shall be provided by the SBR System manufacturer and shall be complete control panel, including all components and wiring as shown on the Drawings and specified herein.

B. Description of Operation:
   1. The Description of Operation for the Wastewater Treatment Plant is contained in Section 17500. All system configuration and programming shall be performed to meet the requirements of this description.

### 1.2 QUALITY ASSURANCE

A. Regulations and Standards:

| | |
|---|---|
| ANSI | American National Standards Institute |
| IEEE | Institute of Electrical and Electronic Engineers |
| ISA | International Society of Automation |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturers Association |
| UL | Underwriters' Laboratories |

B. The control panel components shall be of the most current 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 control panel. The components provided by the System Supplier shall be compatible with the functions required and shall form a complete working system.

C. The SBR Control Panel shall be UL listed as a complete assembly in accordance with UL-508.

### 1.3 SUBMITTALS

A. Shop Drawings:
   1. Submit detailed shop drawings on the SBR Control Panel. Shop drawings shall be complete in all respects and shall include a complete bill of material, catalog information, descriptive literature of all components, wiring diagrams, and panel layout drawings showing dimensions to all devices.
   2. Submit shop drawings on the following software packages:
      a. PLC Programming Software
      b. OIT Programming Software

c. Operator Interface Screens

B. Equipment Certification

At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification for the Sequencing Batch Reactor Control Panel attesting that the manufacturer has examined the Contract Drawings and Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

## 1.4 MEETINGS

A. Coordination Meeting:
1. The SBR Control Panel supplier shall attend and participate in one (1) virtual coordination meeting with the Engineer, the Owner and the Process Control System Supplier to review the controls being furnished for the SBR Control Panel.

B. Operator Interface Terminal Review Meeting:
1. The SBR Control Panel supplier shall attend and participate in a review meeting with the Engineer and the Owner to review the operator interface screens. This meeting will be held at the wastewater treatment plant.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 62** AND CERTIFIES THAT THE **"SBR CONTROL PANEL"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 62**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.
EQUIPMENT: **" SBR CONTROL PANEL"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

## PART 2 PRODUCTS

### 2.1 SBR CONTROL PANEL COMPONENTS

A. Control Panel Enclosure:
   1. The control panel enclosure shall be designed and sized in accordance with the requirements of the Drawings and as specified herein. The control panel enclosure shall be manufactured by Hoffman or Saginaw.
   2. The control panel enclosure shall be a free-standing NEMA 12 enclosure without legs, constructed of 12 gauge steel with continuously welded seams. Panel shall have piano type hinged, overlapping doors with neoprene gasket. Enclosure doors shall be equipped with a heavy-duty 3-point latching mechanism operated by a padlocking handle. Following fabrication, the control panel shall be degreased, cleaned and treated with a phosphatizing process, then primed and painted inside and out with an industrial grade enamel. The inside of the control panel shall be painted white. The exterior color shall be gray.
   3. The control panel components shall be properly identified with an engraved nameplate mounted on the inside of the panel. All components not mounted on the front of the panel shall be mounted to a subpanel. All wiring shall be installed in a neat, workmanlike manner and shall be grouped, bundled, supported and routed horizontally and vertically to provide a neat appearance. All wires leaving the panel shall be terminated at the terminal strips inside the enclosure. Terminals and wires shall be identified in accordance with the Supplier's panel wiring diagrams.
   4. Provide a copper grounding bus bar inside the control panel for terminating all ground wires.
   5. Provide a plastic data pocket in the control panel.

B. Enclosure Light Fixtures:
   1. Provide LED light fixtures in the SBR Control Panel to illuminate the enclosure. The light fixtures shall have a low profile design with a non-yellowing lens cover and a door-activated switch. The light fixtures shall be Hoffman, or equal.

C. Control Circuit Breakers:
   1. Circuit breakers shall be quick-make, quick-break thermal magnetic molded case type, individually mounted and identified. Circuit breakers shall be Allen-Bradley Bulletin 1492-CB, or equal.

D. Surge Protection Devices:
   1. Provide a 120 volt, 1 phase surge protection device in the control panel to protect the panel components from damage which may occur from transient overvoltages caused by lightning or surges on the incoming power line.
   2. The surge protection device shall have an indication light and an alarm contact to indicate if the unit has failed. The alarm contact shall be wired to the PLC.
   3. The surge protection devices shall be Phoenix Contact PLT-SEC-T3-120-FM.

E. Uninterruptible Power Supply (UPS):
   1. Provide a UPS in the SBR Control Panel to power the equipment in the panel. The UPS shall provide lightning and surge protection, spike attenuation, galvanic isolation, noise isolation, and a regulated 120 volt, 1-phase power supply. The power output shall be continuous with no interruptions.

2. The UPS shall be sized based on the maximum power requirements of the control panel and for a minimum run time of 10 minutes. The UPS shall be furnished with two (2) alarm contacts to indicate when the UPS is operating on battery power and when the UPS battery needs replaced.
3. The UPS shall be APC, Allen-Bradley, or equal.

F. 24 Volt DC Power Supplies:
1. Provide 24 volt DC power supplies in the control panel to supply 24 volt DC power for the Ethernet switch and 2-wire instrumentation. The power supplies shall be sized as required.
2. The power supplies shall be wired in parallel with a redundancy module. The power supplies shall be sized as required for the load being powered.
3. Each power supply shall be furnished with a normally open contact that closes when the power supply is operating and the DC power is ok. This contact shall be wired to the controller.
4. The 24 volt DC power supplies shall be Phoenix Contact Quint4 with a Quint-Oring redundancy module.

G. Selector Switches:
1. Selector switches shall be 30.5mm, heavy-duty, non-illuminated. Switches shall have double-break silver contacts. Switches shall be maintained contact type unless otherwise indicated on the Drawings. Provide auxiliary contact blocks on switches where indicated on the Drawings or in the Description of Operation. Provide a black legend plate for each switch with white engraving as indicated on the Drawings. Selector switches shall be Allen-Bradley Bulletin 800T.

H. Push Buttons:
1. Push buttons shall be 30.5mm, heavy-duty, non-illuminated. Push buttons shall have double-break silver contacts. Push buttons shall be momentary contact type and shall be color-coded as indicated on the Drawings. Stop push buttons shall have extended heads. All other push buttons shall have flush heads. Provide a black legend plate for each push button with white engraving as indicated on the Drawings. Push buttons shall be Allen-Bradley Bulletin 800T.

I. Pilot Lights:
1. Pilot lights shall be 30.5mm, heavy-duty, push to test, transformer type with LED lamps. Voltage rating shall be 120 volts. Lens color shall be as indicated on the Drawings. Provide a black legend plate for each pilot light with white engraving as indicated on the Drawings. Pilot lights shall be Allen-Bradley Bulletin 800T.

J. Relays:
1. Relays shall be heavy-duty general-purpose type with 10 amp contacts. Relays shall have terminals, which plug-in to a socket, mounted to the inside of the panel enclosure. Terminals for relays having AC coils shall be pin type, and terminals for relays having DC coils shall be blade type. Contact configuration shall be 3PDT.
2. Relay coils shall operate on 120 volts AC, unless indicated otherwise on the Drawings. Relays shall have an indicator light to indicate the relay coil is energized. Relays shall be Idec RR Series, or equal.

K. Transient Voltage Surge Suppressors for Analog Signal Wiring:
1. Provide a transient voltage surge suppressor in the control panel for analog wiring that originates from outside of the building where the PLC is located, to protect the panel components from damage which may occur from transient overvoltages caused by lightning or surges on the analog signal wiring.
2. The transient voltage surge suppressors shall be Phoenix Contact, or equal.

L. Fuses:
1. All fuses shall be sized as required for the circuit they are protecting. Fuses shall be Bussmann, touch-safe type, or equal.

M. Terminal Blocks:
1. Terminal blocks shall be provided in the control panel for terminating field wiring. All terminal blocks shall be single level type.
2. Terminal blocks shall be rated for 600 volts AC, and shall be identified with a permanent machine printed number in accordance with the terminal numbers shown on the control panel wiring diagrams.
3. Provide 20% spare terminal blocks in the control panel.
4. Terminal blocks shall be Allen-Bradley Bulletin 1492-W4, or equal.

N. Wiring:
1. All wiring shall be stranded copper. Control wiring shall be 16 gauge, 600 volt, Type MTW. Power wiring shall be 600 volt, Type MTW, sized as required.
2. All analog signal wiring shall be 18 gauge twisted pairs with foil shield and drain wire, with 300 volt, 90°C insulation. Drain wires shall be grounded at one end only.
3. All wiring and terminal strips shall be isolated by voltage levels to the greatest extent possible.
4. All wiring shall conform to the following color code:
   a. 120 volt, 1 phase: Black, White
   b. 24vdc: Blue
   c. 120 VAC Control Wires: Red
   d. Ground Wires: Green
5. 120 VAC control wires energized from a source external to the control panel power source shall be yellow.
6. Wiring for intrinsically safe circuits shall be purple.
7. All control wiring shall be tagged at each end with a legible permanent coded wire-marking sleeve. Sleeves shall be white PVC tubing with machine printed black marking. Markings shall be in accordance with the wire numbers shown on the control wiring diagrams, and shall match terminal strip numbers.

O. Nameplates:
1. Provide laminated phenolic nameplates on the front of the control panel. Nameplates shall be black with white engraved letters. Engraving shall be as indicated on the Drawings.
2. Minimum size of engraving for nameplates above pilot devices shall be 1/4". Minimum size of engraving for control panel main nameplate shall be 1".

## 2.2 PLC SYSTEM HARDWARE

A. Programmable Controller:
1. Provide an Allen-Bradley CompactLogix 1769-L33ER programmable controller in the SBR Control Panel to provide for automatic control of the SBR sequence. The programmable controller shall be mounted with the required number of input and output (I/O) modules.
2. The programmable controller shall be furnished with battery-backed RAM memory of sufficient size to meet the requirements of the Description of Operation plus 20 percent spare capacity.
3. The programmable controller shall be furnished with an Allen-Bradley Compact Flash card. The PLC program shall be stored on the Compact Flash card, which shall be installed in the PLC.

B. Programmable Controller Power Supply:
   1. Provide an Allen-Bradley power supply for the programmable controller. The power supply shall be sized as required for the power consumption of the system.

C. Operator Interface Terminal:
   1. An operator interface terminal shall be flush mounted on the SBR Control Panel to display process values, alarm messages and graphic displays, and to provide an interface for the operator to change process setpoints.
   2. The operator interface shall have a 15" TFT color touch screen with a NEMA 4X rating.
   3. The operator interface shall be networked to the PLC via Ethernet. The operator interface shall be furnished with enough memory to meet the requirements of the Description of Operation plus 20 percent spare memory.
   4. The operator interface shall operate on 120 VAC power.
   5. The operator interface terminal shall be Allen-Bradley PanelView Plus 7 1500.

D. Ethernet Switch:
   1. Provide a managed industrial Ethernet switch in the SBR Control Panel to network the following equipment:
      a. PLC-SBR
      b. Operator Interface Terminal
      c. Networking to the Plant-Wide PLC System
   2. The Ethernet switch shall be a stand-alone unit operating on 24vdc power, and shall be furnished with a minimum of two (2) fiber ports, and (6) copper ports.
   3. The Ethernet switch shall be Moxa, N-tron, or Stratix, and shall be the same manufacturer as the switches being furnished by the Process Control System Supplier.

E. Fiber Optic Patch Panel:
   1. Provide a fiber optic patch panel in the SBR Control Panel for terminating the 6-strand fiber optic cable, which runs from the existing BioMag Control Panel to the SBR Control Panel.

## 2.3 COMMUNICATION CABLES

A. Ethernet Cable:
   1. Provide CAT 5e Ethernet cable to network the PLC and operator interface terminal as shown on the Drawings.

## 2.4 PLC AND OIT PROGRAMMING SOFTWARE

A. Programmable Controller Programming and Documentation Software:
   1. Provide a windows based programming and documentation software package for programming the Allen-Bradley programmable controller using a personal computer as a programming terminal. This software package shall be used by the System Supplier to program the programmable controller in the SBR Control Panel.
   2. The programming and documentation software shall be latest version of Rockwell Software RSLogix 5000, Professional Edition.
   3. The programming software shall be turned over to the Owner at the completion of the project.

B. Operator Interface Terminal Programming Software:
   1. Provide a Windows based programming and development software package to program the operator interface terminal using a personal computer. This software package shall be used by the System Supplier to program the operator interface terminal.
   2. The programming and development software shall be the latest version of Rockwell Software Factory Talk View Machine Edition.
   3. The programming software shall be turned over to the Owner at the completion of the project.

## 2.5 SPARE PARTS

A. Provide the following spare parts for the SBR Control Panel:
   1. One (1) PLC power supply
   2. One (1) PLC I/O module for each type utilized
   3. One (1) 24 volt DC power supply for each size utilized
   4. Two (2) general purpose relays for each type utilized
   5. Six (6) fuses for each type and size utilized

B. Spare parts shall be packaged individually in boxes that are clearly labeled with part name and manufacturer's part/stock number.

# PARTY 3 EXECUTION

## 3.1 SOFTWARE PROGRAMMING

A. PLC Programming:
   1. Program the programmable controller in the SBR Control Panel to meet the requirements of the Description of Operation, and as required for automatic control of a 2-basin SBR sequence.
   2. In addition to the programming described in the Description of Operation, all programming normally provided as part of Aqua-Aerobics standard SBR programming shall be provided.
   3. All programming shall be annotated and documented with rung numbers, descriptive comments and I/O identification comments. The beginning of each major sub-system shall be identified in the PLC program.

B. Operator Interface Programming:
   1. General:
      a. Program the operator interface terminal to meet the requirements of the Description of Operation, and as required to display all graphic screens required to control and monitor a 2-basin SBR sequence. All programming and graphic screen development shall be performed as required for a complete and operational system.
   2. Graphic Displays:
      a. Dynamic graphic displays shall be programmed in the operator interface for the process equipment and its associated control strategies. The graphic displays shall be interactive with live data from the programmable controller.
      b. The graphic displays shall include all digital and analog points being monitored by the PLC system.
      c. The graphic displays shall indicate the auto/manual status, run status and alarms for all system equipment.
      d. The graphic displays shall allow the operator to set and adjust all process setpoints, and timer settings for control of the system equipment.

e. The configuration of each graphic screen shall be reviewed with and approved by the Owner and the Engineer.

3. Alarms:
   a. All alarms for the system shall be displayed on the alarm display screen on the operator interface.
4. Monitoring of Process Variables:
   a. All process variables being monitored by the system shall be displayed on the operator interface.

## 3.2 TESTING

A. Field Testing:
   1. Test the operation of each PLC I/O point after the SBR Control Panel is installed.
   2. Analog points shall be tested using a signal generator. Each point shall be tested at 0, 25, 50, 75 and 100% of its full scale range.
   3. Test the operation of each graphic screen programmed in the operator interface and in the HMI software to verify the digital and analog points display correctly on the screen.
   4. Test all control strategies to verify that they function correctly.
   5. Test all alarms in the system to verify that they display correctly.
   6. All testing shall be conducted in the presence of, and to the satisfaction of, the Owner and the Engineer.

## 3.3 TRAINING

A. SBR Control Panel:
   1. Provide eight (8) hours of training for plant personnel on the operation of the SBR Control Panel. Training shall include both manual and automatic modes of operation, troubleshooting procedures, and the use of the operator interface terminal.

**END OF SECTION 44 42 62**

**SECTION 44 42 73.31**
**ALUM BULK STORAGE TANK**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The Contractor shall furnish and install one (1) 2,550 gallon vertical high density cross-linked polyethylene, Type I storage tanks. The tank shall be designed for use for aluminum sulfate (Alum) as described herein. Installation of the tank shall be performed by a certified tank installer. All applicable DEP registration certifications and forms shall be completed by the certified tank installer.

B. Coordinate tank size (height and diameter) with proposed building; provide all accessories either specified or shown per drawings.

### 1.2 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Shop Drawings and Product Data:

1. Submit detailed certified dimensional shop drawings and manufacturer's product data for materials and equipment.
2. Submit complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners and other details.
3. Submit calculations for determination of shell thickness, nozzle reinforcement, and all special elements of the vessel construction and support.
4. Submit certified data on the physical properties of the materials being used.

C. Equipment Certification:

1. At the time of submitting shop drawings submit, on the form provided, the equipment manufacturer's warranty and certification attesting that the manufacturer has examined the Contract Drawings and specifications and that the tank provided will meet the performance criteria and conforms to specification requirements.
2. Tank shall be erected by a PA DEP certified installer. Submit installer credentials and certifications prior to beginning work. Submit installation report demonstrating compliance with PA DEP regulations.
3. Before shipment, submit certified list of tanks containing the same chemical and concentration that have been in service for a period of at least 5 years.

### 1.3 APPLICABLE DOCUMENTS

A. Reference Standards:

1. American Society of Testing Materials (ASTM)
2. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
3. D638 Tensile Properties of Plastics
4. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
5. D883 Definitions of Terms Relating to Plastics
6. D1505 Density of Plastics by the Density-Gradient Technique
7. D1525 Test Method for Vicat Softening Temperature of Plastics

8. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
9. D1998 Stand Specification for Polyethylene Upright Storage Tanks
10. D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
11. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
12. D3892 Practice for Packaging/Packing of Plastics

B. ARM (Association of Rotational Molders) Standards:
   1. Low Temperature Impact Resistance (Falling Dart Test Procedure)
C. ANSI Standards:
   1. B-16.5 Pipe Flanges and Flanged Fittings
D. OSHA Standards:
   1. 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids
E. UBC Code:
   1. Uniform Building Code 1997 Edition

**1.4 QUALITY ASSURANCE**

A. Tanks shall be constructed by a firm that has at least 10 years prior experience in construction of similar polyethylene tanks.
B. All equipment furnished under this section shall be from a single supplier which shall assume full responsibilities for system operation regardless of manufacturer.
C. Testing/Registration:
   1. The tank manufacturer shall have quality control procedures adequate to ensure that all fabrications comply with these Specifications. Quality control shall include in process inspections as well as a final inspection by the manufacturer and written record of these inspections. The objective of manufacturer's quality control and inspection procedure shall be to have the tank comply with the Specifications and Drawings at the time of the first inspection, thus eliminating any need for rework by the manufacturer or a second inspection by the Engineer.
   2. Inspection records shall be made for each tank. Inspection records shall be available to the Engineer. Upon request, manufacturer shall send a copy of his inspection records to the Engineer for review prior to inspection by the Engineer.
D. Tank Registration: The Contractor shall be responsible for registering the tank with the appropriate entity of DEP and shall obtain the required permit prior the initial use of the tank.
   1. The tank shall be registered in the name of the Owner.
   2. The tank registration shall include any required inspections or testing to be performed.
   3. Upon completion of tank registration the Contractor shall provide the Owner with the original permit and registration and shall provide the Engineer with photo copies of both.
   4. Costs associated with inspection services and registration shall be included in the Bid.
E. Final acceptance by the Engineer may be contingent upon satisfactory inspection upon arrival, the delivery and installation at the job site.
F. The tank manufacturer shall perform the tests described below prior to shipping. Test samples shall be taken from the cut out areas of where fittings are inserted in each tank. The Engineer or representative shall have the option of witnessing these factory tests.

**1.5 DESIGN REQUIREMENTS**

A. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equations, but shall not be less than 0.187 in. thick.

T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD

T = wall thickness

SD = hydrostatic design stress, PSI

P = pressure (.433 x S.G. x H), PSI

H = fluid head, ft.

S.G. = specific gravity, g/cm^3

O.D. = outside diameter, in

1. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 100 degrees Fahrenheit for Type I and Type II materials. In accordance with the formula in 6.1, the tank shall have a stratiform (tapered wall thickness) wall.
2. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.
3. The standard design specific gravity shall be 1.65 or 1.9.

B. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Secondary containment tanks shall be designed per standard containment thickness requirements. The secondary containment shall be configured to allow shipment of the primary tank inside of the secondary tank. The shipment shall be done without the aid of additional spacer blocks which can be lost during shipment causing tank damage.

C. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The primary tank top shall be configured to prevent rain water from entering the secondary containment tank. The top head of tanks with 2,000 or more gallons of capacity shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations. The primary tank shall be keyed to the secondary tank preventing primary tank rotation. The secondary containment shall have 115% of the normal fill capacity of the primary tank.

D. Tanks with 2,000 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of empty primary and secondary tanks. Tanks shall be capable of being lifted into position as a unit (primary and secondary tanks).

E. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head. The tie-down lugs shall be designed to allow tank retention in wind and seismic loading situations without tank damage. The primary/secondary tank unit shall be configured to allow direct primary tank base retention for seismic load conditions. The base retention unit shall be anchor bolted to an appropriate structure and not require additional spacer blocks. Refer to section 12.2 for tank tie-down accessories.

**1.6 DIMENSIONS AND TOLERANCES**

A. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

1. The tolerance for the outside diameter of the primary tank, including out of roundness, shall be per ASTM D1998.
2. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

**1.7 TEST METHODS**

A. Test specimens shall be taken from fitting location areas or piggy-back test molds.
B. Low Temperature Impact Test
   1. Test specimens should be conditioned at -40 degrees Fahrenheit for a minimum of 2 hours.
   2. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < 1/2-inch thickness shall be tested at 100 ft.-lb. Test specimens > 1/2-inch thickness shall be tested at 200 ft.-lb.
C. Degree of Crosslinking Test (% Gel - Type I Only)
   1. The test method used is to be the o-xlene insoluble fraction (gel test) per ASTM D2765 Method C. This test method is for determination of the ortho-xlene insoluble fraction (gel) of crosslinked polyethylene.
   2. The percent gel level for Type I tanks on the inside 1/8 in. of the wall shall be a minimum of 60%.
D. Hydrostatic Water Test
   1. The hydrostatic water test shall consist of filling the tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. A hydrostatic water test will be conducted in the field after installation.
E. The tank shall be visually inspected to determine such qualities.

**1.8 WORKMANSHIP**

A. A. The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delaminations that will impair the serviceability of the vessel. Fine bubbles are acceptable with Type II tanks to the degree in which they do not interfere with proper fusion of the resin melt.
B. All cut edges where openings are cut into the tanks shall be trimmed smooth.

**1.9 DELIVERY, STORAGE, & HANDLING**

A. Items to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

**1.10 WARRANTY**

A. The Contractor shall warrant the tanks to be free from defects in materials and workmanship and to be suitable for the applications and chemicals as specified in these Contract Specifications for five years.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

A. The chemical storage tanks described in this section shall be furnished by one of the following manufacturers:
   1. Asssmann Tanks
   2. Poly Processing Co. Inc. Distributed by Coastal Technical Sales, Inc

3. Snyder Industries
4. Approved Equal

## 2.2 DESIGN CRITERIA

A. The Metallocene High Density Cross-linked Polyethylene (MHDCXLPE) tank(s) shall be designed for the following:

| Parameter | Value |
|---|---|
| Tank Name | Aluminum Sulfate Storage Tank; $(Al_2(SO_4)_3$ |
| Diameter | 6. 0 ft - 0.0 in. |
| Straight Wall Height | 144 in |
| Primary Tank Material | MHDXLPE PE Type I |
| Straight Wall Capacity | 2,550 gal |
| Chemical Stored | Aluminum Sulfate |
| Chemical Specific Gravity | 1.3 |
| Chemical Concentration | 48% |
| Tank Color | Natural |
| Number of Tank(s) | 1 |
| Location of Tank(s) | Indoors (Chemical Room) |
| Fill Method | Mechanical |
| Pressure | Atmospheric |
| Temperature | Ambient up to 100 °F |

## 2.3 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
B. Like items of materials, equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
C. Anchor bolts or hold-down devices shall be provided by the Installer or contractor as specified by the certified Engineer.

## 2.4 MATERIALS

A. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer. Type I tanks shall be made from cross-linked polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties. Type II tanks shall be made from linear polyethylene resin as manufactured by ExxonMobil Chemical, or resin of equal physical and chemical properties.
B. All polyethylene resin material shall contain a minimum of a U.V. 8 stabilizer as compounded by the resin manufacturer. Pigments may be added at the purchaser's request, but shall not exceed 0.25% (dry blended) of the total weight.
C. Mechanical Properties of Type I Tank Material:

| Property | ASTM | Value |
|---|---|---|

| | | |
|---|---|---|
| Density | D1505 | 0.938 – 0.946 g/cc |
| Tensile (Yield Stress 2-in/min) | D638 | 3000 psi |
| Elongation at Break (2-in/min) | D638 | > 300% |
| ESCR (100% Igepal, Cond. A,F50) | D1693 | > 1,000 hr |
| ESCR (10% Igepal, Cond. A,F50) | D1693 | > 1,000 hr |
| Vicat Softening °F Temperature | D1525 | 250 |
| Flexural Modulus | D790 | 100,00 psi |

**2.5 TANK FITTINGS**

A. Two (2) 3-in flanged nozzles for installation in vapor phase applications on curved surfaces depending on the spherical dome radius and the placement of the fitting on the tank dome. Should have EPDM gasket.

B. One (1) 4-inch overflow fitting. The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I. Gaskets shall be a minimum of 1/4-inch thickness and constructed of 40-50 durometer EPDM, There shall be a minimum of 4 ea. full thread stainless steel bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be SS metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4-inch of the threads closest to the bolt head.

C. One (1) 2-inch discharge (Transition fitting). This fitting is required to allow the two tanks to move independently of one another. This is extremely important to the life expectancy of the tank

D. All tank fitting attachments shall be equipped self-aligning dome fitting, with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% design movement (movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement).

**2.6 TANK ACCESSORIES**

A. Sealed Top Manway
   1. Sealed manways are available in 24 in. size on certain tanks in selected positions.
   2. The Safe Surge manway shall be constructed of polyethylene material. The bolts shall be polypropylene or other specified material. The gaskets shall be closed cell, cross-linked polyethylene foam.

B. External Fill Pipes
   1. External fill pipes shall be prepared per the customer approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All designs shall be done according to the specific needs of the customer.
   2. All external fill pipes shall be constructed of PVC or other specified materials. Should include ball valves and quick disconnect

C. Tank Fill Enclosure

1. Provide a tank fill enclosure constructed of fiber reinforced plastic (FRP) in accordance with the details shown in the process drawings. The fill enclosure shall be designed to contain spills in a catch basin at the bottom of the enclosure. The catch basin shall have a 2-inch drain port with a PVC ball valve. The opening for the chemical fill line shall be cut in the field.
2. The FRP enclosure shall be contact molded, manufactured in accordance with ASTM D4097. The visual defects, per ASTM D2563, shall not exceed Level II on the vessel interior and Level III on the vessel exterior. The resin used shall be Dow 510, AOC K022, or approved equal suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products. The resin system should provide a class 1 flame spread rating. Antimony, Nyacol or any other additives are not allowed. A permanent wax containing resin coating, formulated according to the resin manufacturer's most recent recommendations (or other Engineer-approved method) shall be used for surface protection and to prevent air inhibition of resin curing. Contact molded accessories shall be manufactured in accordance with NBS PS15. The completed vessel shall be translucent until it is gel coated. The final gel coat color shall be selected by the owner or engineer. A certificate from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin shall be furnished with the vessel.
3. Acceptable Manufacturers:
    a. ECC
    b. Or approved equal

D. Vent
1. Each tank must be properly vented using 6-inch vent with screen.
2. All vents shall be constructed of PVC or other specified materials as shown in the drawings.

## 2.7 TANK LADDERS

A. Ladders
1. Ladders shall be constructed of FRP and shall comply with OSHA standards. Provide ladder with OSHA approved safety climb system. Ladder shall extend down tank pad to containment slab.
2. Ladders must be mounted to the tank to allow for tank expansion and contraction due to temperature and loading changes. All top ladder mounts shall be connected to integrally molded in attachment lugs that allow for tank movement.

B. Tie Down Systems
1. Anchor bolts shall be provided by the contractor per the instruction and the base plates for the system.
2. The tie down system shall be 304 stainless steel.

## 2.8 TANK NAMEPLATE

A. Mark each tank with an encapsulated paper tag or stainless steel nameplate not less than 4-in x 6-in in size and attach to the outside of the tank wall. Raise the nameplate as required when tank is to be insulated. The following information shall be printed on nameplates:
1. Name of Manufacturer
2. Capacity in Gallons
3. Manufacturer Serial Number
4. Year Built

5. Maximum Specific Gravity
6. Design Pressure and Temperature
7. Materials of Construction
8. Tank Dimensions
9. Tank Name

**2.9 TANK HEAT TRACING AND INUSLATION**

A. Heat Tracing:
   1. Heat tracing system for temperature maintenance shall be SilcoPad® tank heating systems designed to maintain a desired product temperature, not to exceed 100 degrees F. Each system shall include tank heating pads and a temperature controller. The quantity and type of SilcoPad® is determined by the size of the tank, the desired temperature maintenance and environmental conditions. Systems shall be available in 30, 60 or 100 degrees F. Tanks are supplied with the heating panels and a controller installed by Poly Processing Company. Power supply to be the only field installation required.
      a. Pads to operate on 120 vac single phase with a maximum power density of 0.5 watts/sq.inch.
      b. Silicone pad heaters must fully comply with Article 427-23 (b) of the National Electric Code.
      c. Temperature controller to be supplied with two electronic thermostats switching the heating system via one solid state relay. Primary thermostat to control desired product temperature and secondary thermostat to provide over temperature protection at 150 degrees F.

B. Insulation:
   1. Insulation used shall be polyurethane foam with a density of 2.5 lb/ft3 with a minimum an “R” value of 6.3/in. The foam shall be applied with a nominal thickness of 2” to the external tank surfaces except the tank bottom.
   2. Upon completion of application and curing of the insulation, 2 full coverage coats oflatex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.

**PART 3 - EXECUTION**

**3.1 DELIVERY INSPECTION**

A. Inspect each tank upon delivery to the project site in the presence of the Owner and the Contractor to assure that no damage was sustained during loading or shipping.

**3.2 INSTALLATION AND TESTING**

A. Furnish and install each tank in accordance with the manufacturer's instructions and the Contract Drawings. Install 24 lb roofing felt (min. 2 layers) under tanks in accordance with manufacturer’s instructions.
B. Obtain and provide the Owner with an Installation Certificate signed by the equipment manufacturer's representative attesting that the tanks have been properly installed and are ready to be placed into operation.
C. Hydrostatically test each storage tank by filling with water to the overflow pipe level. Check tank carefully for leaks. Allow tank to sit for 48 hours, check for leakage. Empty tank when check has been

completed.

D. As part of the bid price, the Contractor shall fill both tanks with 15% sodium hypochlorite after system has been tested and accepted.

**3.3 CERTIFIED TANK INSTALLER**

A. The Contractor shall provide a certified installer to install the tank and certify its installation in accordance with the Storage Tank and Spill Act of 1989 and all applicable regulations. The installer will be required to sign the storage tank registration form, which will be submitted to PADEP by the Owner. The installer's certification must be in the appropriate certification category and must be current. All costs for the above should be included in the Contractor=s bid price.

**END OF SECTION 44 42 73.31**

# SECTION 44 42 75

# SUBMERSIBLE INFLUENT CHOPPER PUMPS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This section includes requirements for furnishing and installing new submersible chopper pumps, guide pipes, brackets and appurtenances in accordance with the contract requirements.

B. Influent chopper pumps to be installed at the:
   1. Influent Pump Station (IPS) wet well
   2. Influent Equalization Box at the Pre-Anoxic Tank

C. Intended purpose: The pumps shall be used for conveying ballasted activated sludge (containing magnetite) and raw wastewater with total suspended solids concentrations up to 6,350 mg/l (including magnetite) from the IPS wet well to the SBRs. The pumps shall be used for conveying raw wastewater to the influent equalization tank when influent flow exceeds 0.60 mgd. The pumps shall be chopper-type pumps meant for handling raw municipal wastewater and typical debris found therein.

### 1.2 SUBMITTALS

A. Layout drawings

B. General arrangement drawings, installation drawings, installation instructions, electrical schematics, wiring and control diagrams, shop drawings, data sheets, catalog cuts, and other such information shall be furnished for review and approval on all equipment and material specified within. Show complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners, and other details.

C. Manufacturer's installation recommendations.

D. The manufacturer shall furnish Operation and Maintenance manuals for all of the equipment specified.

E. Before shipment, submit certified pump performance curves showing head/capacity relationships and required horsepower after pump assembly has been fabricated and performance tested, in accordance with Hydraulic Institute latest standards, at the factory for each pump provided

F. Certification of Installation

G. Motor dimensions, performance data and wiring diagrams and cut sheets for all accessories

H. Equipment Certification

At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification for the Influent Chopper Pumps attesting that the manufacturer has examined the Contract Drawings and Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

## 1.3 QUALITY ASSURANCE

A. The manufacturer shall perform the following inspections and tests on each pump before shipment:
   1. An insulation test of the windings.
   2. A balancing of the motor (rotor).
   3. A test of the pump motor (run dry for 5 minutes at full load) to verify electrical data measurements. All electrical data shall be registered as part of documentation.
   4. A hydrostatic test of the assembled pump where the casing is under hydrostatic head of 75 psi or 150% of rated shutoff head, whichever is greater.
   5. A motor and cable insulation test for moisture content and insulation defects.
   6. A dry run test to verify correct rotation and mechanical integrity. The entire unit is checked for vibration.
   7. A final inspection of propeller, motor rating, and electrical connections for compliance with purchase order.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 75** AND CERTIFIES THAT THE **"SUBMERSIBLE INFLUENT CHOPPER PUMPS"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 75**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **" SUBMERSIBLE INFLUENT CHOPPER PUMPS"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

## PART 2 PRODUCTS

### 2.1 GENERAL

A. The pumps shall be manufactured by:
   1. Vaughan, submersible chopper pump (model numbers provided below)
   2. Or Equal.

B. Pump units shall be approved according to UL standards.

C. All parts shall be designed and proportioned for ample strength and stability for their intended purposes.

D. Pumps shall be designed for continuous-duty.

E. Pump selection shall be based on low energy consumption criteria.

F. Pump installation appurtenances shall permit safe and easy handling of the pumping equipment.

G. Variable frequency drives shall be used to control pump speed.

### 2.2 OPERATING CONDITIONS

**Influent Pump Station Pumps:**

| **Tank Type** | **IPS Wet Well** |
|---|---|
| **Number of Tanks** | 1 |
| **No. of Pumps in each tank** | 2 |
| **Total Number of Pumps** | 2 |
| **Design Flow Rate** | 1792 gpm (each pump) |
| **Design Total Dynamic Head** | 61.4 feet |
| **Type of Liquid** | Raw Wastewater + Ballasted Mixed Liquor |
| **Wet well active volume** | 3,230 gallons |
| **Electrical Service** | 460 V / 3 Ph / 60 Hz |
| **Model** | S6U-460V-105 |

**Influent Equalization Pumps:**

| **Tank Type** | **Influent Equalization Box** |
|---|---|
| **Number of Tanks** | 1 |
| **No. of Pumps in each tank** | 2 |
| **Total Number of Pumps** | 2 |
| **Design Flow Rate** | 1180 gpm (each pump) |
| **Design Total Dynamic Head** | 30.5 feet |
| **Type of Liquid** | Raw Wastewater |
| **Wet well active volume** | 5,000 gallons |
| **Electrical Service** | 460 V / 3 Ph / 60 Hz |
| **Model** | S6U-460V-109 |

Provide sufficient quantity of lubricants to perform the first manufacturer's recommended oil change for all installed pumps.

## 2.3 PUMP DESIGN DATA

**Influent Pump Station Pumps:**

| | | |
|---|---|---|
| A. | Motor Size: | 50 HP |
| B. | Power Supply: | 3 phase /460 volts /60 hertz |
| C. | Propeller Speed: | 1340-1800 RPM |
| D. | Discharge Diameter: | 6" |
| E. | Impeller/Cutter Bar Material: | cast steel |

**Influent Equalization Pumps:**

| | | |
|---|---|---|
| A. | Motor Size: | 20 HP |
| B. | Power Supply: | 3 phase /460 volts /60 hertz |
| C. | Propeller Speed: | 1170 RPM |
| D. | Discharge Diameter: | 6" |
| E. | Impeller/Cutter Bar Material: | cast steel |

## 2.4 PUMP

A. Each pump shall be of the direct drive, submersible type. All components of the pump, including the motor, shall provide continuous underwater operation while the propeller blades are completely submerged.

B. The pump shall be capable of handling typical domestic or industrial raw, screened sewage with normal concentrations of rags, strings, and sand/grit. The pump shall be designed to be easily raised, lowered, and handled for lubrication without personnel having to enter the tank. A suspension bracket and sliding console shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by the guide bracket, which shall handle all thrust created by the pump. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 50 ft.

C. Major pump components shall be of 304 stainless steel or ASTM 316 construction. All exposed nuts and bolts shall be of stainless steel.

D. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied powder coating of a polyester resin paint or Ceram C0 coating.

## 2.5 SUBMERSIBLE MOTOR

A. The submersible motor shall be U/L or FM listed and suitable for Class 1, Group C & D, Division 1 hazardous locations, rated at 50 HP, 1800 RPM, 460 Volts, 60 Hertz and 3 phase, 1.0 service on VFD power with Class F installation. Motor shall have tandem mechanical seals in oil bath and dual moisture sensing probes. Moisture probes must be connected to indicate water instrusion. The lower motor seal shall be exposed only to the lubricant in the pump bearing housing, with no exposure to

the pumped media. Motor shall include two normally closed automatic resetting thermostats connected in series and embedded in adjoining phases. The thermostats must be connected per local, state, and/or the National Electric Code to maintain hazardous location rating and to disable motor starter if overheating occurs. Motor frame shall be cast iron, and all external hardware and shaft shall be stainless steel. Motor shall be sized for non-overloading conditions.

**2.6 CASING**

A. The casing shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. Casing shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Casing shall include a replaceable Rockwell C 60 alloy steel cutter to cut against the rotating impeller pump-out vanes for removing fiber and debris.

**2.7 IMPELLER**

A. Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015-0.025" cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.

**2.8 CUTTER BAR PLATE**

A. Shall be recessed into the pump casing and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.030" of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumping utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

**2.9 CUTTER NUT**

A. The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast alloy steel heat treated to minimum Rockwell C 60.

**2.10 UPPER CUTTER**

A. Shall be treated into the casing or back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast alloy steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.

**2.11 PUMP SHAFTING**

A. Shafting shall be heat treated alloy steel, with a minimum diameter of 1.5 inches in order to minimize deflection during solids chopping.

**2.12 BEARING HOUSING**

A. Shall be ductile cast iron, and machined with piloted bearing fits for concentricity of all components. Piloted motor mount shall securely align motor on top of bearing housing.

**2.13 THRUST BEARINGS**

A. Shaft thrust in both directions shall be taken up by two back-to-back mounted single-row angular contact ball bearings, or a matched set of face to face tapered roller bearings, with a minimum L-10 rated life of 100,000 hours. Overhang from the centerline of the lower thrust bearing to the seal faces shall be a maximum of 1.7". A third mechanical seal (two in motor) shall also be provided to isolate the bearings from the pumped media. The third seal, as well as the thrust bearings shall be oil bath lubricated in the bearing housing by ISO Grade 46 oil. Shaft overhang exceeding 1.7 inches from the center of the lowest thrust bearing to the seal faces shall be considered unacceptable.

**2.14 PUMP MECHANICAL SEAL**

A. The mechanical seal shall be located immediately behind the impeller hub to maximize the flushing available from the impeller pump-out vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a ductile cast iron seal gland.

**2.15 SHAFT COUPLING**

A. The submersible motor shall be close coupled directly to the pump shaft using a solid sleeve coupling, which is keyed to both the pump and motor shafts. Slip clutches and shear pins between the shaft and the motor are considered unacceptable.

**2.16 STAINLESS STEEL NAMEPLATE**

A. Shall be attached to the pump giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

**2.17 GUIDE RAIL SYSTEM**

A. Provide a non-sparking guide rail system consisting of two galvanized or stainless steel guide rails (by others), cast bronze pump guide bracket, cast ductile iron discharge elbow with mounting feet and Class 125 flanges, 316 stainless steel upper guide rail mounting bracket, and 316 stainless steel intermediate guide rail stiffener bracket every 10 feet. System design shall prevent spark ignition of explosive gases during pump installation and removal.

**2.18 SURFACE PREPARATION**

A. Sandblast and coat with a minimum 30 MDFT Tnemec Perma-Shield PL series 431 epoxy (except motor).

B. Motor to have standard manufacturer's submersible motor paint finish.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Pumps shall be installed in accordance with the manufacturer's recommendations.

B. Following completion of the installation the pump manufacturer shall provide the service of qualified representative to verify proper installation and assist in pump startup.

C. Pump manufacturer shall provide four (4) hours of qualified training and maintenance instruction to the Owner's maintenance personnel.

**3.2 FIELD TESTS**

A. The field tests shall determine the RPM, and overall efficiency characteristics of each unit and in addition, shall demonstrate that under all conditions of operation each unit:
   1. Has not been damaged by transportation or installation.
   2. Has been properly installed.
   3. Has no mechanical defect.
   4. Is in proper alignment.
   5. Has been properly connected.
   6. Is free of overheating of any parts.
   7. Is free of all-objectionable vibration and noise.
   8. Is free of overloading of any parts.
   9. Motor and cable insulation shall be tested for moisture content or insulation defects.

   A written quality assurance record confirming the above testing/inspections shall be supplied with each pump at the completion of the field test. The equipment manufacturer shall furnish the services of a factory-trained engineer for the above testing.

**END OF SECTION 44 42 75**

# SECTION 44 42 76

# POST-EQUALIZATION PUMPS

## PART 1 GENERAL

### 1.1 SUMMARY

A. This section includes requirements for furnishing and installing two (2) new submersible post-equalization pumps in the post-equalization tank in accordance with the contract requirements.

B. The new post-equalization pumps shall be installed using the existing base elbows and rails.

C. Intended Purpose: The Post-Equalization Pumps (Post-EQ) is to convey SBR effluent [decant] from the post-equalization basin through the disc filters and eventually to the UV channel. The Post-EQ pumps serve to covey decanted SBR effluent at an attenuated rate through the filters to avoid overloading the filters.

### 1.2 SUBMITTALS

A. Layout drawings

B. General arrangement drawings, installation drawings, installation instructions, electrical schematics, wiring and control diagrams, shop drawings, data sheets, catalog cuts, and other such information shall be furnished for review and approval on all equipment and material specified within. Show complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners, and other details.

C. Manufacturer's installation recommendations.

D. The manufacturer shall furnish Operation and Maintenance manuals for all of the equipment specified.

E. Before shipment, submit certified pump performance curves showing head/capacity relationships and required horsepower after pump assembly has been fabricated and performance tested, in accordance with Hydraulic Institute latest standards acceptance grade 1U, at the factory for each pump provided

F. Certification of Materials and Installation

G. Motor dimensions, performance data and wiring diagrams and cut sheets for all accessories

H. Equipment Certification
At the time of submitting shop drawings, submit the equipment manufacturer's warranty and certification for the Post-EQ Pumps attesting that the manufacturer has examined the Contract Drawings and Specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

### 1.3 QUALITY ASSURANCE

A. The manufacturer shall perform the following inspections and tests on each pump before shipment:

1. A hydrostatic test of the pump case where the casing is exposed to hydrostatic pressure of 30 ft.
2. A motor and cable insulation test for moisture content and insulation defects.
3. A final inspection of propeller, motor rating, and electrical connections for compliance with purchase order.

The above inspections and tests shall be executed under ISO 9001 certification.

EQUIPMENT GUARANTEE CERTIFICATION FORM

Reference: **"SMITHSBURG WWTP ENR UPGRADE AND EXPANSION"**

THE UNDERSIGNED HEREBY ATTESTS THAT HE/SHE HAS EXAMINED THE REFERENCED PROJECT DRAWINGS AND SPECIFICATIONS SECTION **44 42 76** AND CERTIFIES THAT THE **" POST-EQUALIZATION PUMPS"** THAT HE/SHE PROPOSES TO FURNISH AND DELIVER MEETS OR EXCEEDS CONTRACT SPECIFICATIONS, IS SUITABLE FOR THE INTENDED PURPOSE STATED IN SPECIFICATIONS SECTION **44 42 76**, IS SUITABLE FOR INSTALLATION AS PRESENTED IN THE ABOVE PROJECT DRAWINGS AND SPECIFICATIONS, AND WILL PROVIDE SATISFACTORY PERFORMANCE AT THE DESIGN CRITERIA SPECIFIED. THIS GUARANTEE OF SUITABILITY FOR INTENDED PURPOSE IS IN ADDITION TO AND SHALL NOT BE IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED.

EQUIPMENT: **" POST-EQUALIZATION PUMPS"**

MANUFACTURER: _____

Address: _____

_____

By: _____
(Typed Name and Title)

_____/s/_____ (SEAL)
(Signature) (Date)

Equipment Guarantee Certification must be signed by a Principal Person (President, Vice-President, etc.) of the equipment manufacturer. In the event the manufacturer is not the Supplier then a Principal Person of the Supplier must <u>also</u> sign this form.

SUPPLIER: _____

Address: _____

By: _____
(Typed Name and Title)

(SEAL)

_____/s/_____

**PART 2 PRODUCTS**

**2.1 GENERAL**

A. The pumps shall be manufactured by:
   1. KSB, submersible pump, Model KRT K 150-400/226XEG-S
   2. Or Equal.

B. Pump units shall be approved according to UL standards.

C. All parts shall be designed and proportioned for ample strength and stability for their intended purposes.

D. Pumps shall be designed for continuous-duty.

E. Pump selection shall be based on low energy consumption criteria.

F. Pump installation appurtenances shall permit safe and easy handling of the pumps.

G. Variable frequency drives shall be used to control pump speed.

**2.2 OPERATING CONDITIONS**

| **Tank Type** | **Post-Equalization Tank** |
|---|---|
| **Number of Tanks** | 1 |
| **No. of Pumps in each tank** | 2 |
| **Total Number of Pumps** | 2 |
| **Design Flow Rate** | 1615 gpm (each pump) |
| **Design Total Dynamic Head** | 43.74 feet |
| **Type of Liquid** | SBR Effluent |
| **Post-equalization tank active volume** | 95,300 gallons |
| **Electrical Service** | 460 V / 3 Ph / 60 Hz |

**2.3 PUMP DESIGN DATA**

A. Motor Size: 30 HP

B. Power Supply: 3 phase /460 volts /60 hertz

C. Propeller Speed: 1176 RPM

D. Discharge Diameter: 6”

**2.1 MATERIALS**

A. The submersible pump shall be of at minimum, the following grades of materials:

| | |
|---|---|
| Pump casings: | Grey cast iron EN-GJL-250 (A 48 Class 35B) |
| Casing wear ring: | Semi austenitic CrNi stainless steel VG 434 (A 890 Grade |
| Discharge cover: | Grey cast iron EN-GJL-250 (A 48 Class 35B) |
| Shaft: | Stainless steel EN-1.4021+QT800 (A 276 Type 420) |
| Shaft Sleeve: | ---- |
| Impeller: | Grey cast iron EN-GJL-250 (A 48 Class 35B) |
| Impeller wear ring: | Semi austenitic CrNi stainless steel VG 434 (A 890 Grade) |

| | |
|---|---|
| Bearing bracket: | Grey cast iron EN-GJL-250 (A 48 Class 35B) |
| Motor casing: | Grey cast iron EN-GJL-250 (A 48 Class 35B) |
| Cable sheath: | Waterproof synthetic rubber compound |
| Elastomer components: | Nitrile rubber (NBR) |
| Bolts, nuts: | Stainless steel A4 (EN-1.4571) (A 276 Type 316) |

**2.2 PUMP CONSTRUCTION**

A. The pump shall be submersible centrifugal, non-clog, single stage, volute casing, end suction type capable of satisfying the specified performance requirements. The pump shall be designed as "back pull-out" such that the entire rotating assembly can be removed from the casing. The pump shall be suited for continuous operation in a submerged condition driven directly by a full submersible dry squirrel cage induction motor. The impeller shall be fitted directly to the motor shaft.

B. The head-capacity curve shall have a single flow rate for each pumping head valve and have a continuously rising head characteristics from the specified design point to shut-off so as to ensure stability and control in both individual and/or parallel operation. The operating range of the pump as specified, is defined by the maximum and minimum operating heads against which the pump will be required to operate. At no point on the pump's power demand curve between shut-off and the minimum operating head shall be pump's power demand exceed the rated power of the motor.

**2.3 CASING**

A. The pump shall have a volute casing with centerline discharge. The single piece pump casing shall be made of suitable thickness to allow for long pump life and to safely withstand the pressure at shut off head. The discharge nozzle shall be provided with integrally cast flange. Critical mating surfaces where watertight sealing is required shall be machined and fitted with O-rings. Fittings will be the result of controlled compression of rubber O-rings in two plans and O-ring contact of four sides without the requirement of a specific torque limit.

B. Rectangular cross-sectioned gaskets requiring specific torque limits to achieved compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

**2.4 WEAR RINGS**

A. The pump shall be provided with replaceable impeller and casing wear rings to insure efficient sealing between the volute and suction inlet of the impeller. It shall be firmly secured to prevent rotation or displacement.

**2.5 IMPELLER**

A. The impeller shall be of a centrifugal, closed, non-clogging design for high efficiency pumping of industrial and municipal wastewater. It shall have vanes and be capable of handling solids of at minimum 3 inch size, long fibres, sludge and other materials as many normally be found in wastewater. Back vanes shall be provided to minimize axial loads and to propel solids away from the seal area.

B. The impellers lateral cavities shall be of ample size to protect against wet and clogging. The impeller shall be a one piece casting of the material as specified. It shall be smooth, well finished free from blowholes and imperfections, and be dynamically balanced. The impeller shall be securely fitted to the pump shaft

in such a manner that it does not loosen or become detached if the pump is operated in the wrong direction as may happen by reversed flow or reversed motor connections.

**2.6 PUMP SHAFT**

A. The common pump/motor shaft shall be of sufficient size to transmit full driver output with a maximum deflection of 0.05 mm (0.002 inches) measured at the lower mechanical seal. The pump/motor shaft shall be of stainless steel or be completely isolated from the pumped media through the use of a stainless steel shaft sleeve. Do not use carbon steel as a shaft material without using a stainless steel shaft sleeve.

**2.7 BEARINGS**

A. The shaft shall rotate on a minimum 1 / 1 antifriction bearings. The bearing system shall be adequately designed so as to be capable of handling all axial thrust loads plus any and all radii loads. The bearings shall be sealed and lubricated for lifetime.

**2.8 SHAFT SEAL**

A. Each pump shall be provided with two totally independent, mechanical seals, installed in tandem, each with its own independent single spring system acting in a common direction. The sealing shall not depend on the direction of rotation.

B. The primary, impeller-side seal shall operate in a large flooded chamber formed by cast recess in the impeller and backplate. The impeller-side seal shall be of bellow type mechanical seal. The primary and the secondary seal faces shall operate in a generously proportioned lubricant chamber that hydrodynamically lubricates the seal faces to allow for extended periods of dry-running operation without the needs for external seal lubrication or cooling systems. The lubricant chamber liquid shall be an environmentally friendly and nontoxic.

C. The seal face material of the primary seal shall be of at minimum Silicon Carbide versus Silicon Carbide (SiC/SiC) for excellent hardness and chemical resistance across the entire “pH” range. The secondary seal shall be of Carbon versus Silicon Carbide (Carbon/Sic). The seal faces may be of a solid material capable of being-relapped. The seals shall require neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.

D. Mechanical seal metal parts shall be of CrNiMo-stainless steel.

E. Seals shall be non-proprietary in design, and shall be available from another vendor in addition the pump manufacturer.

F. Conventionally double mechanical seals with a single or multiple springs acting in opposed direction, cartridge-type mechanical seals; seals with materials other than those specified; shall not be considered as adequate for this critical sealing area.

**2.9 BOLTS AND NUTS**

A. All nuts and bolts exposed to the pumped media shall be of stainless steel as specified.

**2.10 NAMEPLATE**

A. Each pump shall be provided with a stainless steel nameplate firmly attached to the pumping unit. It shall be clearly and durable inscribed with the manufacturer's name, year of manufacturer pump-type, serial number, and principal rating data. For each identification of the submerged pumping unit, a second equal nameplate shall be supplied along with its documentation for attachment outside the wet well.

## 2.11 PROTECTIVE COATING

A. All exterior metal surfaces of the pump shall be subject to following preparation and coating procedure except name plates, bright parts and stainless steel parts.

B. The preparatory temperature of cast and welded components shall be accomplished in accordance with SSPC near white SP 10.

C. The primer when using Zinc dust or Zinc phosphate base shall have a dry film thickness of not less than 1 ½ mils (35 microns).

D. An abrasion and shock-resistant nonporous 2 components epoxy resin base coating shall be used. It shall be resistant against many diluted acids and brines as well as grease, oil, solvents and sweater and especially suited for use in hydrous media. The solids content shall not less than 82%. The shop-applied top coat shall have a dry film thickness of not less than 6 mils (150 microns). The color shall be preferably Ultramarine Blue.

E. Name plates shall be masked or removed prior to surface preparation and coating. Polished and surfaces (shafts, couplings) shall not be painted but preserved against corrosion. The coat of stainless steel parts is not required but acceptable.

## 2.12 INSTALLATION

A. The pumps shall be installed using the existing base elbows and guide rails.
   1. Existing base elbows dimensions to be field verified by the contractor
   2. Existing guide rail diameter to be field verified by the contractor

## 2.13 MOTOR

A. The motor shall be three-phase, dry squirrel-cage induction type in design. The motor shall be adequately sized and rated for continuous operation to at maximum a fluid temperature of 104°F (40°C).

B. The motor housing shall be both air filled and watertight. Motor protection shall be at minimum IP 68. Allowable maximum submergence shall be not less than 100 ft. (30m).

C. The motor shall be rated for supply voltage of 460 V and frequency of 60 Hz and accept voltage fluctuations as per range A of IEC 60034-1 (Supply voltage +/- 5% supply frequency +/- 2%). The motor shall be explosion proof to CSA, NEC, FM Class I, Div. 1, Gr. C+D.

D. The motor shall be designed for a maximum of 10 number of starts per hour.

E. The motor stator shall be wound using Class H monomer-free polyester resin insulation resulting in an overall motor rating of 311°F (155°C), Class F. The stator windings shall be Current-UV-Dip-Impregnated resulting in a winding fill factor of at least 90%. The rotor bars and short rings shall be made of cast aluminum.

F. The motor and pump set complete shall be designed and manufactured by the same company.

**2.14 ELECTRIC CABLE AND CABLE ENTRY**

A. All power and control cables shall be suitable for the flexible connection of the submersible pumps, sized in accordance with NEC, FM, IEC requirements and shall be Ozone, UV, weather, oil and water resistant.

B. The conductors shall be made of finely-stranded copper to Class 5 of IEC 60228. Each conductor shall be insulated by ethylene-propylene-rubber (EPR). An inner sheath of rubber shall also be utilized. The cable outer sheath shall be water and oil-resistant and made of Neoprene. Each cable shall be rated for 600/1000 V and maximum conductor temperature of 194°F (90°C).

C. The power and control cables shall be of 45 ft. length.

D. Each cable entry seal shall be rated for a submerged depth to 100 ft. (30 m).

E. A triple sealed cable entry design along with strain relief and a bend protection shall be provided.

F. Firstly, the cable entry seal shall consist of a elastomer grommet compressed by two stainless steel washers, sealing the outside of the cable against the cable entry casing. Secondly, the entire end of the cable shall be sealed inside the cable entry housing through the use of a non-shrink epoxy resin. Thirdly, a monolithic dam formed by either solder on bare stripped section or by an inserted Copper bushing shall seal each individual cable lead making sure that no entry of moisture is possible into the high-voltage motor terminal area even if the cable is damaged or severed below water level.

G. Cable entries providing only simple rubber grommet (external cable jacket) seals will not be accepted. If a triple sealed cable entry as described is not utilized in the pump's design, then the pump shall have installed a separate moisture sensor mounted in the separated terminal area to shut the pump down should moisture approach the high voltage terminal area.

**2.15 MOTOR THERMAL PROTECTION**

A. Temperature monitors shall be embedded in the motor windings for use in conjunction with and supplemental to external motor overload protection. These temperature sensitive switches shall allow for direct integration with the motor control circuit to shut down the pump if high temperatures are detected. The switches shall be normally closed rated for 250 V AC and a current of not less than 2 A. The temperature monitors shall automatically reset once motor temperature returns to normal.

**2.16 MOTOR HOUSING MOISTURE PROTECTION**

A. A moisture detector shall be mounted in the motor's stator cavity allowing a control panel mounted relay to de-energize the motor should leakage occur.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Pumps shall be installed in accordance with the manufacturer's recommendations.

B. Following completion of the installation the pump manufacturer shall provide the service of qualified representative to verify proper installation and assist in pump startup.

C. Pump manufacturer shall provide four (4) hours of qualified training and maintenance instruction to the Owner's maintenance personnel.

**3.2 FIELD TESTS**

A. The field tests shall determine the RPM, and overall efficiency characteristics of each unit and in addition, shall demonstrate that under all conditions of operation each unit:
   1. Has not been damaged by transportation or installation.
   2. Has been properly installed.
   3. Has no mechanical defect.
   4. Is in proper alignment.
   5. Has been properly connected.
   6. Is free of overheating of any parts.
   7. Is free of all-objectionable vibration and noise.
   8. Is free of overloading of any parts.
   9. Motor and cable insulation shall be tested for moisture content or insulation defects.

   A written quality assurance record confirming the above testing/inspections shall be supplied with each pump at the completion of the field test. The equipment manufacturer shall furnish the services of a factory-trained engineer for the above testing.

**END OF SECTION 44 42 76**

# SECTION 44 53 49

# SHEAR MILL

## PART 1 GENERAL

### 1.1 SUMMARY

A. This section includes requirements for furnishing a shear mill for the Biomag Building in accordance with the contract requirements.

B. The intended purpose of the shear mill is to separate magnetite from biological activated sludge floc that together make up the ballasted activated sludge to allow wasting of activated sludge and recovery of magnetite.

### 1.2 SUBMITTALS

A. General arrangement drawings, installation drawings, installation instructions, electrical schematics, wiring and control diagrams, shop drawings, data sheets, catalog cuts, and other such information shall be furnished for review and approval on all equipment and material specified within. Show complete information concerning materials of construction, fabrication, protective coatings, installation, anchoring and layout requirements, fasteners, and other details.

B. Manufacturer's installation recommendations.

C. The manufacturer shall furnish Operation and Maintenance manuals for all of the equipment specified.

D. Motor dimensions, performance data and wiring diagrams and cut sheets for all accessories

### 1.3 QUALITY ASSURANCE

A. The manufacturer shall perform the following inspections and tests on the shear mill before shipment:
   1. An insulation test of the windings.
   2. A balancing of the motor (rotor).
   3. A test of the motor to verify electrical data measurements. All electrical data shall be registered as part of documentation.
   4. A dry run test to verify correct rotation and mechanical integrity. The entire unit is checked for vibration.
   5. A final inspection of rotor/stator, motor rating, and electrical connections for compliance with purchase order.

## PART 2 PRODUCTS

### 2.1 GENERAL

A. The shear mill shall be manufactured by:
   1. Charles Ross & Son Company (model number provided below)
   2. Or Equal.

B. All parts shall be designed and proportioned for ample strength and stability for their intended purposes.

C. Shear mill shall be designed for continuous duty.

D. A variable frequency drive shall be used to control rotor speed.

**2.2 DESIGN CRITERIA**

| | |
|---|---|
| Model (basis of design) | HSM-410 Inline High Shear Mixer |
| Mixing Characteristic | High Shear |
| Design Flow | 50 gpm at 30 PSI |
| Rotor Blade Diameter | 4” |
| Rotor Speed | 3,450 rpm |
| Motor Size | 10 HP |
| Power Supply | 3 phase /460 V/ 60 Hz |
| Service Factor | 1.15 |
| Inlet Size | 2.5” |
| Outlet Size | 2” |

**2.3 ROTOR/STATOR**

A. Rotor and stator material shall be cast Stellite.

B. Rotor shall consist of four (4) blades, 4” diameter.

C. Stator head shall be slotted.

**2.4 DRIVE ARRANGEMENT**

A. Rotor shall be driven by a direct drive assembly.

B. Drive assembly shall have a double mechanical seal with silicon carbide vs. silicon carbide seal faces, Viton O-rings and a maximum operating pressure of 130 psig.

C. A stainless steel seal barrier fluid tank with sight gauge and internal cooling coil mounted on a vertical riser will be provided for use with double mechanical seal.

**2.5 MIXING CHAMBER**

A. All product contact parts not specified above shall 316 stainless steel construction.
   1. All interior stainless steel surfaces shall have a 32Ra machined finish

B. All elastomers shall be Viton

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Shear mill to be provided as shelf spare.

**3.2 WARRANTY**

A. Manufacturer to provide one-year warranty from equipment startup.

**END OF SECTION 44 53 49**

**SECTION 46 33 00**
**ALUM LIQUID CHEMICAL FEED EQUIPMENT**

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Aluminum sulfate (Alum) Feed System
B. Accessories and appurtenances

### 1.2 SYSTEM DESCRIPTION

A. The contractor shall furnish all labor, materials, equipment and incidentals required and deliver, and place into satisfactory operation, the aluminum sulfate (alum) feed system as specified herein and as shown on the plans.
B. Aluminum Sulfate (Alum) Feed System:
   1. One (1) single skid-mounted alum feed pump and one (1) triplex skid-mounted alum feed pumps, to be located in the Chemical Room of the Filter Building (Denitrification Filters). All of the skids will be fed from the 2,550-gallon storage tank to the respective alum addition points. The alum addition points are the following:
      a. Sequential Batch Reactor (SBR) No.1 (by triplex skid-mounted alum feed pump No. 1 and tagged as 50P-111)
      b. Sequential Batch Reactor (SBR) No.2 (by triplex skid-mounted alum feed pump No.2 and tagged as 50P-112)
      c. Alum feed pump No.3 will serve as a spare for either SBR No.1 or SBR No.2 (by triplex skid-mounted feed pump and tagged as 50P-113).
      d. Denitrification Filters' effluent pump station's wet well (by single skid-mounted alum feed pump No.4 and tagged as 50P-114).
   2. All pumps shall have the capability of being operated in either AUTO or MANUAL mode. Yet, only one feed pump shall be in AUTO mode at any given time.
   3. The alum addition dosage will be adjusted either manually or automatically via the 4-20 mA signal provided by the Operation Building's PLC-OP. When operating automatically, the orthophosphate analyzer 50AIT-100, will be sending a 4-20 mA signal to the Operation Building's PLC-OP AIT-100 which in turn will control the corresponding alum feed pump that is in AUTO mode. When in MANUAL mode, the pump speed can be adjusted manually.
   4. An orthophoshate analyzer, tagged as 50OPA-100, will be located in the surrounding area of the Denitrification Filter's influent box. Its purpose will be to sample, analyze and maintain an effluent targeted total phosphorus of 0.8 mg/L.

### 1.3 REFERENCES

A. Section 40 05 00 - Process Piping
B. Section 40 05 23 - Process Valves and Appurtenances
C. Section 40 06 20 - Schedules for Process Piping
D. Section 40 90 00 - Primary Process Measuring Devices
E. Section 26 29 01 - Programmable Logic Control Equipment
F. Section 26 29 02 - Process Control Panels and Hardware

**1.4 SUBMITTALS**

A. Submit in accordance with Section 01 30 00.
B. Product Data and Shop Drawings: As defined in Section 01 30 00.
C. Operation and Maintenance Data: As defined in Section 01 78 23.
D. Complete drawings, details, and specifications covering the pumping equipment, spill containment pallets and accessories shall be submitted in accordance with the submittals section.
E. Characteristic pump performance curves showing flow rate as a function of flow rate, tube diameter, and pressure.
F. Approval/permitting from authorities having jurisdiction prior to substantial completion.

**1.5 QUALITY ASSURANCE**

A. Coordination: The Contractor shall coordinate the work between the suppliers of equipment to be used with or connected to the feed system to ensure that all required provisions for mounting the accessories are included.
B. The System Manufacturer shall be responsible for the coordination of corrosion-resistant materials for the chemical solutions specified. The manufacturer shall include all features as necessary for satisfactory operation of the pumping systems for chemical solutions specified. Pumps shall perform satisfactorily over the full range of solution concentrations specified

**1.6 DELIVERY, STORAGE AND HANDLING**

A. Deliver, store, protect and handle products to site under provisions of Section 46 00 00.

**1.7 WARRANTY**

A. Provide in accordance with Section 01 78 00.

**PART 2 - PRODUCTS**

**2.1 CHEMICAL, TUBE TYPE, METERING PUMPS**

A. Metering Pump - Shall be a positive displacement, peristaltic type tubing pump with a brushless variable speed motor, non-spring loaded roller assembly located in the pumphead, integral tube failure detection system, tube life roller revolution counter with user alarm set-point and flexible tubing with attached connection fittings.
    1. There shall be no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.
    2. Pump shall be capable of 24 hour continuous duty, self-priming and operating in either direction of flow at the rated maximum pressure of up to 30 PSI.
    3. Pump shall be capable of running dry without damage.
    4. Pump shall be capable of operating in either direction without output variation.
    5. Suction lift shall be 30 feet of water.
    6. Accuracy: +/- 0.5 percent of full scale. Repeatability: +/- 2.0 percent.
    7. Pump shall be warranted by the manufacturer for a period of five (5) years. Warranty shall include chemical damage to the pump head and roller assembly for a period of two (2) years.
B. Pumphead - Shall be a single, unbroken track with a clear removable cover

1. Tube failure detection sensors shall be wholly located in the pumphead. Tube failure detection system shall not trigger with water contact. Float type switches shall not be used. Process fluid waste ports or leak drains shall not be provided.
2. The pump head cover shall be clear, annealed acrylic thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall be positively secured to the pump head using a minimum of four thumb screws. Tools shall not be required to remove the pump head cover.

C. Pump Tube Assembly:
1. Only tubing provided by the manufacturer is acceptable.
2. Pump tube shall be assembled to connection fittings of PVDF material.
3. Tube sizes and connections shall be measured in inches.

D. Drive System - Shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure.
1. Power: 115 VAC, 60 HZ, 1 Phase.
2. Motor:
   a. Reversible, brushless DC gear motor rated for continuous duty.
   b. Motor shall include overload protection.
   c. The maximum gear motor RPM shall be 125 RPM.
3. Enclosure:
   a. Pressure cast aluminum with acidic liquid iron phosphate three-stage clean and coat pretreatment and exterior grade corrosion resistant polyester polyurethane powder coat.
   b. Rated NEMA 4X (IP66).
   c. Provided with chemical resistant floor/shelf level mounting brackets and hardware.
   d. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads to un-pluggable type terminal block connectors.
4. Control Circuitry:
   a. All control circuitry shall be integral to the pump and capable of adjusting the pump motor speed from 0.01% to 100.00% in 0.01% increments less than 1% motor speed and in 0.1% increments greater than 1% motor speed (10,000:1 turndown ratio).
   b. The pump output shall be capable of being manually controlled via front panel user touchpad controls.
   c. The pump output shall be capable of being remotely control via 4-20mA analog input.
   d. The pump shall include an internal cycle timer capable of automatically cycling the pump on and off. The pumping total cycle time shall be adjustable from 1 to 999999.9 seconds.
   e. The pump shall be capable of dispensing upon demand. The dispensing shall be manually triggered by pressing the front panel start button or by inputting a contact closure.
   f. The pump shall be capable of automatically calculating the pump motor speed required to achieve a part per million dosing output that is proportional to a fixed system flow rate.
   g. The pump shall be capable of automatically calculating the pump motor speed required to achieve a part per million dosing output that is proportional to a variable system flow rate.
   h. The pump shall include an 11-button front panel user touchpad control with a multi-color VGA graphic LCD display.

i. The pump shall include a user selectable 4-20mA and 0-1000Hz output signal which are scalable and proportional to pump output volume.
j. The pump shall include four contact closure alarm outputs. Three rated at 1A-115VAC, 0.8A-30VDC and one rated at 6A-250VAC, 5A-30VDC.
k. Provide a four digit password protected configuration menu.
l. The Pump shall include a roller revolution counter display (tube life indicator) with user programmable alarm set-point.

E. Safety:
1. Tube Failure Detection (TFD) system sensors shall be wholly located in the pumphead. TFD system will stop the pump within three seconds of leak detection. To prevent false alarms due to rain, wash-down, condensation, etc., tube failure detection system shall not trigger with water contact. Process fluid waste ports or leak drains shall not be provided.

F. Chemical, Tube Type, Metering Pump Skids' System Schedule
1. The chemical, tube type, metering pumps should be sized according to the following table:

| Parameter | Alum Feed |
|---|---|
| Number of Skids | One (1) |
| Quantity of Pumps per Skid | One (1) |
| Pump(s) Tag Number(s) | 50P-114 (No.4) |
| Fluid<br>Specific Gravity<br>Solid Content (%) | Aluminum Sulfate<br>1.29 – 1.34<br>45 - 55 |
| Capacity<br>Min (gph)<br>Design Average (gph)<br>Maximum Monthly (gph) | <br>0.3<br>3.0<br>7.5 |
| Max pump (RPM) | 125 |
| Suction Pressure<br>Max Positive Static Head (ft)<br>Max Suction Lift (ft) | <br>10.0<br>< 5.0 |
| Max Discharge Pressure (psig) | 30 |
| Pump Tube Size (mm) | 6.4 |
| Pump Pipe Connection (in) | 1/2 |
| Motor (Hp) | 0.50 |
| Power (DC, Phase, Frequency) | 115, 1, 60 |
| Tube Material | Norprene® |
| Calibration Columns | One (1) |
| Discharge Ports | One (1) |
| Inlet Ports | Two (1) *[1] |
| Discharge Pressure Gauges | One (1) |
| Signal Source | 4-20 mA |

*Notes:*

1) *Second port to be used as sampling port or drain*

G. Acceptable Manufacturers:
   1. Blue-White Inc. Pro-Series M
   2. Or Approved Equal

**2.2 CHEMICAL, HOSE TYPE, METERING PUMPS**

A. Metering Pump - Shall be a positive displacement, peristaltic type hose pump with an inverted duty variable speed motor, integral hose failure detection system, hose life roller revolution counter with user alarm set-point and flexible tubing with attached connection fittings.
   1. Capable of operating in either direction without flow variation
   2. Capable of running dry without damage to pump or hose
   3. Capable of pulling 95% of full vacuum
   4. Repeatability: + 1% accurate
   5. Valve-less and glandless design with no dynamic seals in contact with the pumped product.
   6. Direct Coupled gear drive arrangement as specified herein.
   7. Pump hardware shall be galvanized steel.
   8. Pump shall be warranted by the manufacturer for a period of two (2) years.

B. Hose and Lubricant
   1. The hose shall be constructed from an appropriate elastomer re-enforced by two or more braided nylon layers. Hose shall normally be constructed from a combination of a Natural Rubber outer and an inner made from Natural Rubber, Nitrile Buna Rubber or Hypalon. Where EPDM material is required the hose shall be constructed totally from this material. Hose shall have a permanent color coded material identifier bonded onto the hose's outer cover and this identification shall be incorporated along the entire length of the hose. Identification of hose material by means of partial color coding or by labels of any form shall be unacceptable. Hose shall not require additional processing such as machining to maintain wall thickness and maintain consistent hose occlusion. Exterior surface of hose shall be textured to increase adhesion of lubricant on the portion of hose not otherwise submerged, in order to better cool and lubricate the upper-half of the hose.
   2. All hoses regardless of size shall be rated for a minimum of 175 PSIG continuous operation and have a minimum burst pressure of 800-PSIG.
   3. Durometer: 53-68 shore A.
   4. Hose must be replaceable without cover or pump removal.

C. Pump Housing
   1. Pump housing shall be cast iron ASTM A35 and shall be supplied with an internal bearing hub to support the rotor on its own bearings. Provide a threaded drain plug at the lowest point of the pumping chamber to allow complete drainage of lubricant.

D. Pump Rotor
   1. Rotor shall be cast iron ASTM A48 Class 45B (DIN GG30) with integrally mounted pressing shoes located 180 degrees apart. Manufacturer shall supply the rotor applicable for the conditions in the Pump Schedule.

E. Internal Bearing Frame
   1. Pump rotor shall be independently supported on its own set of heavy duty ball bearings such that the bearings are located directly under the rotor's load. Bearings shall be supported by the

bearing hub located within the pump housing and shall be sealed via a dynamic seal. Bearings shall be sealed and greased for life. Pumps which use pump lubricant to lubricate the bearings, external bearing frames which allow overhung loading and require long coupling configurations, or close coupling where the rotor is not supported by pump bearings are not acceptable. Gearing shall be direct coupled to the back of the pump housing and shall be completely isolated from the process fluid and pump fluid through the sealed bearing hub. Gear unit and drive components shall be serviceable without removal of the pump rotor.

F. Flanged Connectors
   1. Supply pump with flanged inlet and outlet to ANSI/ASA 150 lbs standards with wetted inserts compatible with the process fluid as indicated in the Process Pump Schedule. Flange construction shall be of 316 stainless steel.
   2. Pump hose shall extend from the pumping chamber to allow visual confirmation of hose/flange insert connection. Securing the hose using multiple clamps or internal compression fittings that cannot be visually verified as secure without disassembly of the pump is not acceptable.
   3. Flange supports shall be of one piece construction and shall secure to the pump housing via two or four bolts to maintain a compression seal between the pump housing and hose. Flange support construction shall be of 316 stainless steel.

G. Pump Cover
   1. Pump cover shall be constructed of ASTM A48 Class 40 cast iron.
   2. Viewing Window: Equip cover with a viewing window constructed of PMMA to allow clear visual confirmation of direction of rotation. Window shall be marked with a minimum lubricant registration mark for proper indication of lubricant level when pump is stationary.
   3. Cover Mounting: Pumps shall bolt to the pump housing and shall be sealed via a gasket seal.

H. High Lubricant Leak Detector
   1. Provide a float type magnetic reed switch or pressure sensor located near the top of the pump to detect leakage of pumped product into the pump housing. Pump shall turn off in the vent of chemical leakage.
   2. Supply sensor Normally Closed with the ability for field adjustment to Normally Open
   3. Float switch shall be rated to the following maximums:
      Vmax = 240VAC, Imax = 1 Amp, Pmax = 50VA

I. Revolution Sensor
   1. Provide inductive type sensor and/or magnetic sensor to detect rotor revolutions. Mount sensor on the rear of the pump housing and/or in between the suction and discharge ports on the pump.
   2. Pump manufacturer to supply sensor only. Contractor is responsible for any additional equipment which may be required to integrate this into their control system.

J. Drive System
   1. Direct Coupled Gearing with Fully Protected Drive mounting:
      a. Provide gearing with Fully Protected Drive direct-coupled mounting to the pump housing.
      b. The gearbox shall bolt directly to the pump housing which shall include a buffer zone between the gearing and pumphead to prevent gearbox contamination from pump fluid or lubricant in the event of a hose lubricant seal failure. The pump's internal bearing hub shall be vented through the rear of the pump housing to allow visual detection in the event of a hose lubricant seal failure.

c. Close coupled pump designs which utilize the gearbox to seal the pump housing and expose the gearbox to lubricant or pumpage are not acceptable.
d. Long coupled pumps which require external couplings, coupling alignment, and coupling guards are not acceptable.
e. Design gear reduction to match output speed requirement of the pump using two or three-stage gearing and matching torque rating of pumping equipment. Gearing shall be classified for continuous heavy shock duty, 24 hr duty with a minimum of 1.4 service factor. The gearing shall be provided with a cast iron housing.

2. Motors
a. Provide premium efficient, TEFC or TENV, squirrel-cage induction motors, NEMA C face, conforming to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards gearing with Fully Protected Drive direct-coupled mounting to the pump housing.
b. Provide motor HP in accordance with Process Pump Schedule.
c. Motors are to be designed for continuous duty for 3-phase, 230/460VAC operation, NEMA Design B with torque and starting currents in accordance with NEMA MG1-1993-12.35 and 12.38. Ratings to be based on a 40 degree C ambient 3,300 feet altitude or lower operation with a maximum temperature rise of 80 degree by resistance C at 1.0 service factor (and 90 degree C rise 1.15 service factor).
d. Motors shall be furnished with Class F insulation utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motors shall have 1.15 service factor but shall be selected for operation within their full load rating without applying the service factor.
e. Bearings shall be selected to provide L10 rating of 100,000 hrs minimum for C-face flexible coupled applications. For frame sizes 56-140, bearings shall be permanently lubricated. For frame sizes 180 and larger, proved capped grease fitting.
f. For frame sizes 180 and larger, motor enclosure including frame, end brackets locking bearing inner caps, fan guard, and conduit box and cover shall be cast iron, ASTM Type A48, Class 25 or better. Conduit box shall be diagonally split with tapped NPT threaded conduit entrance hole, neoprene conduit box cover gasket, neoprene lead seal gasket between box and motor frame, and ground lug. For frame sizes 56-140, motor enclosure, fan guard, conduit box, and cover shall be carbon steel. End shield shall be constructed of aluminum. Conduit box shall be top mounted with F1/F2 conduit entrance holes, grounding lug, and neoprene conduit box gasket between box and motor frame.
g. External cooling fan on TEFC motors shall be corrosion resistant, non-sparking, bi-directional, keyed, clamped, and shouldered on the motor shaft.
h. Motor rotor construction shall be die cast aluminum, fabricated copper, or their respective alloys. Motor shall have copper windings.
i. Motor leads shall be nonwicking type permanently numbered for identification.
j. All motors shall be premium efficient with minimum efficiencies exceeding NEMA MG1-1993 Table 12-10. Motor efficiency shall be determined in accordance with NEMA MG1-1993-12.58.1 and full load efficiency labeled on motor nameplate in accordance with NEMA MG1-1993-12.58.2

k. Motors shall suitable for use with PWM type variable frequency drives. Motors frame size 56-180 shall be rated for 10:1 constant torque continuous duty over 6-60 Hz. Larger frame motors shall be rated for 4:1 constant torque continuous duty over 15-60 Hz.
l. Provide motor overload to shut down the respective pump in the event of overheating.
m. Acceptable Manufacturers:
    1) Baldor
    2) Or Approved Equal

K. Pressure Relief Valve
1. One (1) pressure relief valve shall be located per discharge side of each pump per skid to prevent excessive pressure in the system. Fluid shall be returned to the inlet side of the system if the pre-set maximum system pressure is exceeded.
2. The valve shall be SCH 80 CPVC with a PTFE diaphragm seal.
3. The pressure adjustment screw and lock nut shall be polypropylene.
4. Infinite adjustment increments from 5 to 100 psi shall be possible.
5. An outlet safety vent port shall be provided with 1/8-inch F/NPT connection.

L. Calibration Cylinder
1. One (1) calibration column shall be provided in the inlet side of each pump and as indicated in Table 1 to permit metering pump output volume calibration.
2. Valves shall permit the cylinder to be filled by gravity or by by-passing the chemical metering pump output into the cylinder.
3. The cylinder shall be PVC with PVC end caps.
4. An outlet vent shall be provided with ¼-inch ID tubing barb connection.

M. Pressure Gauge with Guard
1. One (1) pressure gauge shall be provided on the discharge side of each pump and as indicated in Table 2.
2. The liquid filled gauge shall be stainless steel and include a blow-out plug.
3. The gauge shall be bottom mounted to the guard with ¼-inch NPT stainless steel threads.
4. The temperature compensated oil filled gauge guard shall be PVC.
5. The pressure gauge should have an isolation valve.

N. Chemical, Hose Type, Metering Pump Skids' System Schedule
1. The chemical, hose type, metering pumps should be sized according to the following table:

| Parameter | Alum Feed |
|---|---|
| Number of Skids | One (1) |
| Quantity of Pumps per Skid | One (3) |
| Pump(s) Tag Number(s) | 50P-111 (No.1)<br>50P-112 (No.2)<br>50P-113 (No.3) |
| Fluid<br>Specific Gravity<br>Solid Content (%) | Aluminum Sulfate<br>1.29 – 1.34<br>45 - 55 |
| Capacity Min (gph)<br>Design Average (gph)<br>Maximum Monthly (gph) | 20<br>84<br>198 |

| | |
|---|---|
| Max pump (RPM) | 125 |
| Suction Pressure<br>Max Positive Static Head (ft)<br>Max Suction Lift (ft) | <br>25<br>< 5.0 |
| Max Discharge Pressure (psig) | 174 |
| Pump Hose Size (mm) | 25 |
| Pump Pipe Connection (in) | 1.0 |
| Motor (Hp) | 0.50 |
| Power (VAC, Phase, Frequency) | 460,3, 60 |
| Hose Material | Natural Rubber |
| Calibration Columns | Three (3) |
| Discharge Ports | Three (3) [1] |
| Inlet Ports | Two (2) [2] |
| Discharge Pressure Gauges | Three (3) (One/Pump) |
| Signal Source | 4-20 mA |

*Notes:*

1) *Each discharge whall be interconnected with an isolation ball valve to divert flow*
2) *Second port to be used as sampling port*

O. Acceptable Manufacturers:
   1. Verder Dura Series
   2. Or Approved Equal

**2.3 PRE ENGINEERED CHEMICAL METERING PUMP SKID**

A. Each chemical metering pump set shall be mounted on a pre-engineered and constructed skid.
   1. The triplex alum, hose type, feed metering pumps' set skid shall be anchored to a an equipment pad by the south wall of the Filter Building's Chemical Room, as shown on the Contract Drawings.
   2. The single alum, tube type, feed metering pump's set skid shall be anchored to an equipment pad by the south wall of the Filter Building's Chemical Room, as shown on the Contract Drawings.

B. Metering skid:
   1. The system is complete with the skid assembly containing chemical metering pump/s, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The skid piping design shall minimize the amount of glued joints in the system. All valves and pump connections shall be union type socket end, threaded connection are only permitted on pulsation dampeners where required or on gage isolators where required. The skid shall be of either molded or welded design only. No bolted sheet skids will be acceptable. All wiring between the pumps and the skid mounted junction box shall be run through the skid wall making the wiring internal to the skid and protected from the environment as much as possible. Pipe materials shall be constructed of SCH 80 PVC pipe for aluminum sulfate applications.
   2. The metering pump skid shall contain the following items:
      a. Molded or welded skid with built in containment area.
      b. Flow sensor/verification device, flow meter to meter the amount of chemical pumped as well as a flow verification device.

c. Strainer shipped separate for mounting next to the skid
d. NEMA 4 X Junction Box with Din rail.
e. Discharge manifold. The manifold shall have all necessary ports for mounting devices listed below, one for each pump.

3. Each manifold shall contain the following:
a. Pressure gauge with diaphragm separator.
b. System High Point/Pressure Drain with valve.
c. Pressure relief valves for each pump
d. Pulsation dampener
e. Pump discharge supply port
f. System discharge port with valve.

C. Calibration Cylinder - One (1) calibration column shall be provided per metering pump skid to measure/calibrate the pump(s) output flowrate.
1. Valves shall permit the cylinder to be filled by gravity or by by-passing the chemical metering pump output into the cylinder.
2. The cylinder shall be PVC with PVC end caps for aluminum sulfate applications. An outlet vent shall be provided with ¼-inch ID tubing barb connection.

**2.4 CONTROLS**

A. General: See individual Sections of Division 40 for control and related equipment requirements.
B. Inputs/Output:
1. One (1) input 4-20 mA signal for remote speed control
2. One (1) output for motor speed display

**2.5 SPARE PARTS**

A. Provide spare parts that are identical to and interchangeable with parts installed. Furnish and deliver the following spare parts:
1. Two (2) spare tubes for each chemical metering pump.
2. One (1) maintenance kit for each pressure relief valve for each pump skid
3. One (1) maintenance kit for each back pressure valve for each pump skid
4. One (1) Parts list for all serviceable components

**2.6 SHOP TESTING**

A. Non-witnessed Inlet Testing:
1. 1. Tests shall be conducted on the actual pumps, control panels, and skids being provided for the project. All pumps shall be tested.
2. 2. Each skid system must be tested prior to shipment. The test can be performed with water and not with chemical. The system shall be operated throughout the entire operating range of the pumps, in all automatic and manual modes.
3. In the event that specified tests indicate that the pump does not meet specifications, Engineer has the right to require complete tests for the pump at no additional cost to the owner.
4. Repeat tests until specified results are obtained.
5. Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to the Owner.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Complete in accordance with Section 46 00 00.

### 3.2 INSTALLATION

A. Complete in accordance with Section 46 00 00 and manufacturer's instructions.
B. Install, level, and align respective chemical metering skids as indicated on Contract Drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
C. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.
D. Prior to applying electrical power to motors or control equipment, check all wiring for tight connections. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.
E. Contractor must insure all pipes connected to the pumping system are supported to prevent piping loads from being transmitted to pumps or system piping.

### 3.3 LAYING CHEMICAL FEED PIPE

A. Chlorinated polyvinyl chloride (CPVC) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.
B. Plastic piping shall not be installed when the temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer

### 3.4 FIELD QUALITY CONTROL

A. Prior to acceptance by the Owner, an operational test of all chemical metering pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

### 3.5 TESTING AND STARTUP

A. Complete in accordance with Section 46 00 00.
B. Field test the respective chemical metering pumps at design conditions after installation is complete to assure that equipment has been furnished and installed in full accordance with the specifications. Testing shall be completed at the expense of the Contractor. Any modifications required to the equipment to demonstrate performance at design conditions after installation shall be at no additional cost to the Owner.

### 3.6 MANUFACTURERS START-UP SERVICES

A. Complete in accordance with Section 01 78 00 and Section 46 00 00.

B. The manufacturer shall furnish the services of trained technical representatives for a minimum of half (1/2) man-day to provide for a satisfactorily operating system chemical per chemical skid-mounted metering unit. Provide manufacturer's instructions. Services to be included are as follows:

C. Startup and Performance Testing: Provide startup and performance testing services consisting of the following:

1. Obtain and provide the Owner with an Installation Certificate (Section 01 77 00) signed by the equipment manufacturer's representative attesting that the equipment supplied under this contract and existing equipment that has been reinstalled has been properly installed and is ready for start-up and performance testing.
2. The unit shall perform to pump the specified material over the flow range provided in these specifications; modification may be made to the unit to produce the specified result providing the modification does not alter the basic design or operating characteristics.
3. Operation Instructions and/or Operator Training: Provide a total of half (1/2) man-day on-site work day per chemical skid-mounted metering unit to instruct plant operators for equipment supplied. Training shall consist of field instruction for the proper operation and maintenance of the specific equipment at this installation.

**3.7 CLEANUP AND HOUSEKEEPING**

A. Provide in accordance with Section 01 78 00 and Section 46 00 00.

**END OF SECTION 46 33 00**

**SECTION 46 66 56**
**ULTRAVIOLET DISINFECTION SYSTEM**

## PART 1 GENERAL

### 1.1 DESCRIPTION

A. The Work of This Section includes, but is not limited to:
   1. A low pressure high intensity Variable Power Ultraviolet (UV) Disinfection System
   2. Temporary UV Disinfection System during construction.

B. Related Work Specified Elsewhere:
   1. Section 03 30 00 - Cast-in-Place Concrete
   2. Division 26 - Electrical

C. Description of Work:
   1. The system shall be complete with UV banks, power distribution, system control, and support rack as shown on the Contract Drawings and specified herein.

### 1.2 QUALITY ASSURANCE

A. Design Criteria:
   1. The UV system shall provide the specified disinfection capability with the following influent characteristics:
      a. Flow:
         1) Minimum Flow Rate: 0.5 MGD
         2) Peak Flow Rate: 3.6 MGD
      b. Quality:

| Condition | Suspended Solids (mg/L) |
|---|---|
| Average Monthly | 30 |

   2. Minimum Ultraviolet Transmittance at 253.7 nm: 65%

B. The UV disinfection system shall produce an effluent conforming to the following discharge requirements with two channels in operation: 126 fecal coliform/100ml, based on a 30-day Geometric Mean fecal coliform and not greater than 1000/100 mL in more than 10% of the samples tested. Grab samples shall be taken in accordance with the PA DEP-US EPA approved laboratory methods.
   1. The UV system will be designed to deliver a minimum UV dose of 32,000 cWs/cm2 at peak flow, in effluent with a UV Transmission of 65% after reductions for quartz sleeve absorption, sleeve fouling, and at end of lamp life (EOLL). The basis for evaluating the UV dose delivered by the UV system will be the manufacturer's bioassay as carried out by an independent third party. Bioassay validation methodology to follow protocols described in the US EPA Design Manual B Municipal Wastewater Disinfection (EPA/625/1-86/021), without exception.
   2. The UV Dose will be adjusted using an end of lamp life factor of 0.5 to compensate for diminishing lamp output over one year of lamp operation. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analyzed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).
   3. The UV Dose will be adjusted using a quartz sleeve fouling factor of 0.8 when sizing the UV system in order to compensate for attenuation of the minimum dose due to sleeve fouling during

operation. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected and analysed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

4. Independent Validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer.
5. The system will be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.
6. The system will be designed for complete outdoor installation.
7. The system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.
8. The UV disinfection system supplied shall be CSA, or UL approved.
9. The system shall be designed for complete outdoor installation.

C. The UV system shall operate in an open channel, be of modular design, use high intensity low pressure UV lamps, electronic ballasts with multiple power settings, and incorporate an automatic in-situ mechanical/chemical cleaning system.

D. Performance Criteria:
   1. With the peak design flow rate through the single channel, provide a final treated effluent with a fecal coliform level less than 200 MPN/100 ml at suspended solids concentration equal to or less than 30 mg/l into the UV units.

E. Laboratory Testing:
   1. Laboratory tests for UV transmittance suspended solids and fecal coliform bacteria will be performed by an independent testing agency engaged and paid by the Contractor and approved by the Engineer.

F. The UV disinfection system shall be Trojan System UV 3000 Plus as manufactured by Trojan Technology, Inc., 3020 Gore Road, London, Ontario, Canada, N5V 4T7 (519)457-3400 or equal.

G. The UV tank and equipment arrangement shown on the contract drawings is based on the use of a Trojan Technology, Inc. UV system. The Contractors use of the other specified manufacturer shall include all costs for revising the concrete tank layout, UV equipment layout, electrical power and control wiring, conduit, and feed equipment as required to properly install the UV system. The Contractor will be required to submit revised process mechanical drawings, revised structural drawings, revised structural calculations, and revised electrical drawings detailing the changes required. The revised drawings and calculations are to be sealed by a professional engineer registered in the State of Maryland. No shop drawings for the other specified UV manufacturer will be accepted until the revised drawings and calculations have been reviewed and approved by the Engineer. The other specified manufacturer utilizes panel mounted electronic ballasts which are to be located in a NEMA 4X stainless steel air conditioned enclosure

## 1.3 SUBMITTALS

A. General: Submit in accordance with Section 01 30 00.

B. Shop Drawings and Product Data:
   1. Submit detailed dimensional shop drawings and manufacturer's product data for materials and equipment, including wiring and control diagrams. Show complete information concerning

materials of construction, fabrication, protective coatings, installation and anchoring requirements, fasteners, wireway details, and other details.

C. Equipment Certification:
   1. At the time of submitting shop drawings submit on the form provided, Section 00 62 33.10, the equipment manufacturer's warranty and certification attesting that the manufacturer has examined the Contract Drawings and specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.
   2. Submit certified results of performance from two installations utilizing the same type of equipment to be provided in this contract.
   3. Submit certified results of all start-up and performance tests.

D. Maintenance Data and Operating Instructions:
   1. Provide the required number of Operation and Maintenance Manuals for the equipment furnished including detailed description of function of each principal component, procedures for operation, instructions for overhaul and maintenance. Include lubrication schedule, safety precautions, test procedures and parts lists.

E. Maintenance Material: (Spare Parts)
   1. Provide one complete set of the manufacturer's recommended spare parts including but not limited to:
      a. Spare Parts and Additional Equipment:
         1) 10 UV lamps
         2) 10 Quartz Sleeves
         3) 10 Lamp Holder Seals
         4) UV Module Maintenance Rack
         5) 4 Gallons of Cleaning Solution
      b. Safety:
         1) Two (2) face shields shall be provided to block UV light wavelength between 200 and 400 nm.
   2. Package each part individually or in sets in moisture-proof containers or wrappings, clearly labeled with part name and manufacturer's part/stock number. Submit, in writing, storage procedures for spare parts to ensure adequate protection after delivery.
   3. Provide any special tools required for equipment maintenance. Provide a list of all equipment and tools needed to maintain and calibrate equipment.

F. Control Systems Programming and Maintenance: Provide a complete printout and restorable copy on disk media, of all UV systems PLC programs in their final as-installed form. Provide cross-referenced printout listing all I/O references and addresses identified with the device and function. Provide a cross-referenced list of all system setpoints, timers and sequencing values, I/O typical operating values, operating ranges for normal system values, all system messages and console information, and all warning and alarm level values. Provide full operations and maintenance training manuals for all software and hardware. The Owner will sign a non-disclosure agreement before receiving this information.

G. Performance Test Report

**1.4 FIELD SERVICES**

A. Provide the services of a manufacturer's representative experienced in the installation and operation of the equipment supplied under this specification for not less than three 8-hour workdays on-site for installation inspection, start-up and testing, and instructing the Owner's operating personnel in operation and maintenance of the equipment.
B. Provide for the above services to be performed during two separate visits to the project site.

**1.5 WARRANTY**

A. A two (2) year warranty shall be provided for the UV disinfection system. The warranty shall cover all system components described in this Specification. The UV lamps shall be warranted for 12,000 hours of actual lamp operation based upon a maximum number of four on/off cycles per day. If a lamp fails within the first 9,000 hours of operation, a new lamp shall be provided at no charge. Lamp failure after 9,000 hours, the Owner will be credited proportional to the hours not used.

**1.6 LAMP DISPOSAL**

A. The UV Manufacturer shall ensure disposal of returned lamps (old/used) at no cost to the Owner upon receipt of the returned lamp to the manufacturing headquarters. Shipping costs will be the responsibility of the Owner.

**PART 2 PRODUCTS**

**2.1 DESIGN PARAMETERS**

A. The UV system shall be installed in one open channel having the dimensions as shown on the Contract Drawings.
B. System Configuration:
   1. The UV system shall fit within the UV channel as shown on the Contract Drawings.
   2. The UV system configuration shall be as follows:
      a. Number of Channels: 1
      b. Number of Banks per Channel: 2
      c. Number of Modules per Bank: 3
      d. Number of Lamps per Module: 6
      e. Number of System Control Centers: 1
      f. Number of UV Detection Systems: 2
      g. Number of Power Distribution Centers: 2
      h. Number of Level Controllers 1

**2.2 SYSTEM MANUFACTURE AND CONSTRUCTION**

A. General:
   1. All welded metal components in contact with effluent shall be Type 316L stainless steel.
   2. All metal components above the effluent shall be Type 304 stainless steel.
   3. All wiring exposed to UV light shall be Teflon coated.
   4. All material exposed to UV light shall be Type 316 stainless steel, Type 214 quartz, or Teflon.
   5. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of the UV module and not exposed to the effluent.
B. Lamp Array Configuration:

1. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow.
2. Systems with a concentric array or uniform staggered array and having an equivalent UV density shall have 30% additional lamps to compensate for the inefficiencies of these arrays as shown on Page 206, Fig. 7-33 of the US EPA Design Manual.
3. The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.

C. UV Module:
1. Each UV module shall consist of UV lamps with an electronic ballast enclosure mounted on a Type 316L stainless steel frame.
2. Each lamp shall be enclosed in its individual quartz sleeve, one end of which shall be closed and the other end sealed by a lamp end seal.
3. The closed end of the quartz sleeve shall be held in place by means of a retaining O-ring. The quartz sleeve shall not come in contact with any steel in the frame.
4. The ends of the lamp sleeve shall not protrude beyond the stainless steel frame of the UV module.
5. Lamp wires shall terminate in the electronic ballast enclosure located in the top of the UV module.
6. The electronic ballast enclosure shall contain the electronic ballasts and addressable lamp status monitoring systems.
7. Each UV module shall be connected to a receptacle on the Power Distribution Center by means of a multiconductor cable with a molded connector.
8. At the point of exit from the UV module frame the multiconductor cable shall pass through a waterproof strain relief.
9. The UV modules shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves.
10. Each UV module shall have a minimum rating of Type 6P.

D. UV Lamps:
1. Lamps shall be high intensity low pressure amalgam design. The lamp shall be preheated to promote longevity.
2. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
3. Electrical connections shall be at one end only.
4. Each connection shall have four pins.
5. Lamps shall be rated to produce zero levels of ozone.
6. The barrier shall be dielectrically tested for 2500 volts.
7. Lamps shall be operated by electronic ballasts with variable output settings.
8. Replacement lamps shall be available from at least two (2) active lamp manufacturers.

E. Lamp End Seal and Lamp Holder:
1. The open end of the lamp sleeve shall be sealed by means of a sleeve cup and compresses the sleeve O-ring.
2. The sleeve nut shall have a knurled surface to allow a positive hand grip for tightening. The sleeve nut shall not required any tools for removal.

3. The lamp shall beheld in place by means of a molded PVC lamp holder which shall incorporate two seals. The lamp holder shall incorporate a double seal against the inside of the quartz sleeve to act in series with the external O-ring seal.
4. The second seal on the lamp holder shall isolate and seal the lamp from the module frame and all other lamps in the module.
5. In the event of a quartz sleeve fracture, the two seals of the lamp holder shall prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.
6. The lamp holder shall also incorporate a UV resistant plastic stop that shall prevent the lamp sleeve from touching the steel sleeve cup.

F. UV Lamp Sleeves:
1. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.
2. Lamp sleeves shall be domed at one end.
3. The nominal wall thickness shall be 1.5 mm.

G. UV Lamp Module Support Rack:
1. The module support rack shall be Type 304 stainless steel and be mounted above the effluent in the channel allowing adjustment to the precise height of the channel.
2. The module support rack shall be designed so that no ultraviolet light shall radiate above the channel when the UV lamp modules are energized and fully immersed in the effluent.

H. Effluent Level Controller:
1. Serpentine Weir
   a. Located at the discharge end of each UV channel.
   b. Designed to maintain a minimum channel effluent level as required to keep lamps submerged.
   c. Constructed of Type 304 stainless steel, and other non-corroding materials.

I. Electrical:
1. Each module shall be powered from a Power Distribution Center through a bus bar and shall include a ground detection/fused relay board and watertight connector.
2. Each ballast shall drive two lamps.
3. Power factor shall not be less than 98% leading or lagging.
4. Electrical supply to the Power Distribution Center shall be 277/480 volts, 3 phase, 4 wire (plus ground), 12.3 kVA.
5. Electrical supply to the hydraulic systems center shall be 480 volts, 3-phase, 3 wire (plus ground), 2.5 KVA amps.
6. Electrical supply to the System Control Center shall be 120V, 1-phase, 2 wires (plus ground) 15 amps.
7. Electrical supply to the low channel level sensor from the PDC panel shall be 12VDC.

J. Power Distribution Center:
1. Power distribution shall be through environmentally sealed receptacles to allow for local connection of UV modules.
2. Data concentration shall be through integrated circuit boards located inside the Power Distribution Center.
3. One circuit breaker will be provided for each UV module and will be located inside the PDC.

4. Enclosure material shall be Type 304 stainless steel. Provide stainless steel support legs for each enclosure.
5. All internal components shall be sealed from the environment.
6. All PDCs to be CSA approved with a minimum rating of NEMA 4X.

K. Control and Instrumentation:
1. System Control Center:
a. The operation of the UV system shall be managed at the system control center by a PLC based controller which continuously monitors and controls the system functions. PLC will be a Compact Logix PLC as manufactured by Allen Bradley.
b. The operator interface, display screen, and message keypad will be menu driven with automatic fault message windows appearing upon alarm conditions. PLC Operator Interface will be a Panelview 1250 Plus as manufactured by Allen Bradley.
c. Keypad will have a sealed membrane overlay covering all functions keys and numerical keys.
d. Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include:
1) Low UV Intensity: Pre-set at 80% of the intensity after 100 hours burn-in of the lamp.
2) Multiple Lamp Failure.
3) Module Communication Alarm
4) Lamp Failure
e. The 100 most recent alarms will be recorded in an alarm history register and displayed when prompted.
f. Bank status will be capable of being placed either in Manual, Off or Auto mode.
g. Banks will be cycled for equal wear and timed off to minimize bank cycling.
h. Elapsed time of each bank will be recorded and displayed on the display screen when prompted.
i. Panel will be CSA approved or equivalent, rated Type 4X.
j. Digital I/O modules rated for 3 amps will be provided to remotely indicate status and alarms such as:
1) Common Major Alarm Condition – provide three separate alarm dry contacts
2) Bank Status (one for each UV bank supplied)
k. Control system will control and monitor position of the two motorized influent slide gates to each of the two UV channels and bring channels on-line as needed. The gate actuators “remote” status, open status, and closed status contacts will be wired to the system control center. The system control center will perform failure monitoring for each gate and output “Failed to Open” or “Failed to Close” alarms to the panel terminal strip. Also “Open” and “Closed” status contacts shall be wired to the terminal strip.
l. System control center to include capability for remote diagnostics by manufacturer’s service technicians through a modem connection.
m. All of the UV system graphic displays and alarms shall be capable of being transmitted via the future plant data highway to the plant’s Central Control System.

L. UV Detection System: A submersible UV sensor shall continuously monitor the UV intensity produced in each bank of UV lamps. The sensor shall measure only the germicidal portion of the light emitted by the

UV lamps. The detection system shall be factory calibrated.

M. Dose-Pacing:
   1. A dose-pacing system shall be supplied to modulate the lamp UV output in relationship to a 4-20mA input effluent flow signal. This flow signal, in conjunction with entered UV transmission values shall cause channels and banks to be brought online and taken off line as needed to insure proper disinfection at all times. This includes automatic operation of each channels influent gates.
   2. The dose-pacing system shall allow the operator to vary the design dose setting. Logic and time delays shall be provided to regulate the UV bank On/Off cycle.
   3. The effluent flow transmitter will send a 4-20mA signal proportional to flow to the UV system control center. The system control center PLC shall provide three 4-20mA analog outputs proportional to the plant effluent flow to be utilized for an effluent flow recorder, pacing effluent composite samples and for sending to future plant central control system.

N. Hydraulic System Center (HSC):
   1. One (1) HSC will be supplied to house all components required to operate the automatic cleaning system.
   2. Enclosure material of construction will be Type 304 stainless steel.
   3. The HSC will contain a hydraulic pump complete with integral 4-way valve and fluid.

O. Cleaning System:
   1. System to have mechanical and chemical cleaning abilities, complete with an automatically initiated and controlled cleaning cycle.
   2. The cleaning system, including both mechanical and chemical components, shall be fully operational without requiring either lamps or modules be placed out of service.
   3. Cleaning cycle intervals to be field adjustable within the range of once/24 hours to once/500 hours. Remote Manual and Remote Auto cleaning control to be available through the operator interface.
   4. The system shall be provided with the required cleaning reagents and solutions necessary for initial equipment testing and for equipment start-up.
   5. The hydraulic system that operates the cleaning system shall be housed in a NEMA 4X hydraulic system panel.
   6. The hydraulic pump complete with integral four way valve and fluid reservoir shall be housed inside the hydraulic system panel and shall be used exclusively to operate the sleeve cleaning system.
   7. One pressure gauge and fluid level indicator shall be located on the exterior of the panel for monitoring.
   8. The panel shall act as a secondary containment unit for the hydraulic fluid reservoir.
   9. Provide all necessary hydraulic hoses to extend from the system hydraulic center to each power distribution panel. Provide each hose with the necessary quick disconnect fittings having spring load check valves that prevent hydraulic fluid leakage when the hose is disconnected.

P. Alarms:
   1. Provide dry individual dry contact closure outputs for multiple lamp failure, low UV intensity, and common alarm for each UV bank (6 alarms total). Alarm contacts shall be wired to the panel master terminal strip.

Q. Water Level Sensor:

1. One low water level sensor will be included for each UV channel.
2. During manual, automatic and remote modes of system operation, the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.
3. Power supply to water level sensor will be 12 volts DC via the PDC panel.

R. Module Lifting Device:
1. One portable module lifting device and two crane bases will be supplied to assist in removing individual modules from the effluent channel.
2. Lifting device will be a crane with hand winch and will include an adjustable boom to ensure adequate reach and height. The maximum weight of crane shall be 75 lbs. The crane bases shall be stainless steel and permanently fastened with stainless steel bolts.
3. Lifting device to include a swivel handle for rotation and positioning.
4. Crane, base, and UV module lifting sling will be supplied by the manufacturer and will be installed by the Contractor.

S. Photometer:
1. A single beam UV photometer with front panel and 100% transmittance control adjustment will be supplied to measure the UV transmittance of effluent.
2. The range will be 0-100% transmittance with a wavelength accuracy monitoring plus or minus 0.16 half band width.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

A. Install ultraviolet disinfection equipment specified in this section in accordance with the manufacturer's instructions and under the direction of the manufacturer's field representative.

B. Interconnect all ultraviolet and power control modules. Make all electrical connections to control panels.

C. Obtain and provide the Owner with an Installation Certificate, Section 00 62 33.12, signed by the equipment manufacturer's representative attesting that the equipment has been properly installed and is ready for start-up and performance testing.

**3.2 START-UP AND PERFORMANCE TESTING**

A. Switch on unit under supervision of manufacturer's representative and in the presence of the Engineer to demonstrate proper functioning of the system. Check ultraviolet lamp numbering, lampout LED's and elapsed timer operation. Demonstrate all alarm and control functions.

B. The Owner’s personnel shall collect two simultaneous grab effluent samples per day at the farthest downstream point of the UV structure in accordance with permit conditions and normal operating procedures for fecal coliform testing and by the PA DEP-US EPA approved laboratory method. Suspended solids testing will be based on the same grab samples. The results shall be tabulated by date along with the effluent flow and total suspended solids data, and a fecal coliform geometric average shall be calculated for the 30 consecutive day points. The UV transmittance shall also be recorded at the time the samples are taken. The results shall meet the criteria specified in Part 1. The Owner will be responsible for collecting all samples, performing the required laboratory testing on all samples, and for tabulating all of the data. The Contractor, if they so choose can also collect samples, perform the

required laboratory testing and tabulation of data. A sample will be considered invalid if suspended solids concentration exceeds those stated in Part 1 or if the UV transmittance is less than that stated in Part 1 and will not be grounds for failure of the test.

C. Failure of the performance test shall result if the geometric mean of 30 consecutive fecal coliform tests is found to exceed the geometric mean of 126 MPN/100 ml or if the fecal coliform count is greater than 1000/100 mL in more than 10% of the samples tested. A sample will be considered invalid if SS concentration exceeds those stated in Part 1 or if the UV transmittance is less than that stated in Part 1 and will not be grounds for failure of the test. The day will count and testing will continue. The Engineer may terminate the performance test at any time. When testing resumes, the day count will be the next consecutive day after the test was terminated. If one day of the test fails, corrections or modifications to the UV system shall be made and the thirty (30) day test shall be restarted.

D. Submit report

**3.3 EQUIPMENT ACCEPTANCE**

A. Adjust, repair, modify or replace any components which fail to perform as specified and rerun the tests. Make final adjustments to the equipment under the direction of the manufacturer's representative and to the satisfaction of the Engineer.

**TEMPORARY UV DISINFECTION SYSTEM**

**4.1 CONSTRUCTION BYPASS GENERAL**

A. The Contractor shall provide temporary UV disinfection during the construction of the full-scale UV replacement system as specified in this section.
B. The temporary UV disinfection system shall be provided by the specified full-scale system UV supplier and used by the Contractor for a period of 6 weeks.
C. The temporary UV disinfection system shall be installed by the Contractor and tested and commissioned by UV supplier
D. The temporary UV disinfection system shall deliver an independently validated MS2 Reduction Equivalent UV Dose of >30mJ/cm$^2$ at 65% UVT at 2.6 MGD.

**4.2 CONSTRUCTION BYPASS - MATERIALS**

A. The construction bypass UV disinfection system shall be a mobile UV system provided by specified full-scale system UV supplier.
B. The construction bypass UV disinfection system shall be permanently installed on a flatbed trailer. The unit must be placed on a level surface. The construction bypass UV system footprint is 53’ 1 1/16” x 19’ with storage doors open. The unit weights approximately 72,000 lbs. when pumping effluent and should not be parked on grass or soil. Parking ground should be asphalt or hard-packed gravel.
C. The UV disinfection system shall have one (1) channel, with inlet and outlet transition boxes at either end, one (1) Power Distribution Center (PDC) and one (1) Hydraulic System Center (HSC). UV system control shall be by a System Control Center (SCC). All items to be permanently mounted on the trailer.
D. The mobile UV system shall have one (1) bank of twelve (12) 1000 W, low-pressure, high-output lamps in a stainless-steel channel. The unit shall also contain an automatic chemical/mechanical cleaning system. Only one (1) electrical connection shall be required to power up the entire unit. All panels and control center shall be permanently wired.

**4.3 CONSTRUCTION BYPASS - RESPONSIBILITIES**

A. UV Supplier Responsibilities
    1. Supply one (1) trailer-mounted temporary UV system to the Contractor for the duration of the construction period.
    2. Set-up the construction bypass UV equipment with the assistance of the Contractor
    3. Provide a 16” flanged magnetic flow meter
    4. Instruct operators on the operation of the unit.
    5. Be available for consultation and, if necessary, UV system troubleshooting.
    6. Provide enough replacement parts necessary to maintain operation of the UV system.
B. Contractor Responsibilities During Construction Bypass Period
    1. Provide a suitable site location and on-site preparation
    2. Ensure wastewater quality is available for the construction bypass UV system, as specified
    3. Provide power to the system
    4. Install the magnetic flow meter upstream of the construction bypass UV system
    5. Provide influent pipe work to the construction bypass UV system (16-inch inlet)

6. Provide effluent pipe work from the construction bypass UV system capable of discharging anticipated peak flows up to a maximum of 2.6 MGD by gravity via 2 x 12-inch flanged discharge.

**4.4 CONSTRUCTION BYPASS - EXECUTION**

A. Parking and Landing Gear
   1. Contractor shall ensure trailer is parked on a level surface. Once the trailer is in its final position, the four (4) landing gears shall be extended. Each landing gear has its own level.
   2. Contractor shall confirm the trailer is level prior to processing flow.
   3. Contractor shall ensure appropriate height clearances and allow sufficient space around the trailer for ladder access at the back and storage compartment access on the side of the trailer.

B. Electrical Requirements
   1. Contractor shall engage the assistance of a local qualified electrician to connect plant power directly to the Main Disconnect mounted on front deck of the UV trailer.
   2. Power Requirements:
      a. 480 Volt AC
      b. 60 Hz
      c. 3 Phase, 4-wire + ground
      d. 30 kVA
   3. Main Disconnect to be fused at 45 amps

C. Inlet and Discharge Pipe Connections
   1. One (1) 16” inlet AWWA Class B Flange located near the front of the trailer shall be connected by Contractor to a pump and flow meter.
   2. Two (2) 12” outlet AWWA Class B flanges located near the back end of the trailer shall be used for gravity discharge. Contractor shall note the elevation in the area where the trailer is to be parked with respect to the other elevations in the permanent and temporary pumping, filtration, disinfection, and effluent discharge processes, when developing the bypass and construction bypass disinfection system.

D. Flow Meter
   1. One (1) 16” flow meter shall be provided for the use of capturing flow data during the construction bypass UV operation. The flow meter is temporarily mounted at the front deck of the trailer and can be lifted off and removed for installation at inlet by fork truck or crane. The weight is approximately 300 lbs.
   2. A grounding ring shall also be provided and installed at the flow meter with gaskets.
   3. Flow direction shall be as indicated on the flow meter.

**4.5 CONSTRUCTION BYPASS - INSTALLATION**

A. In accordance with contract drawings, manufacturer’s shop drawings and instructions.

**4.6 CONSTRUCTION BYPASS - MANUFACTURER'S SERVICES**

A. Installation assistance: As required for proper installation prior to start up
B. Start-up and field testing: 3 days on site, including all travel expenses
C. Operator Training: 1 half-day on site

**4.7 CONSTRUCTION BYPASS - DOCUMENTATION**

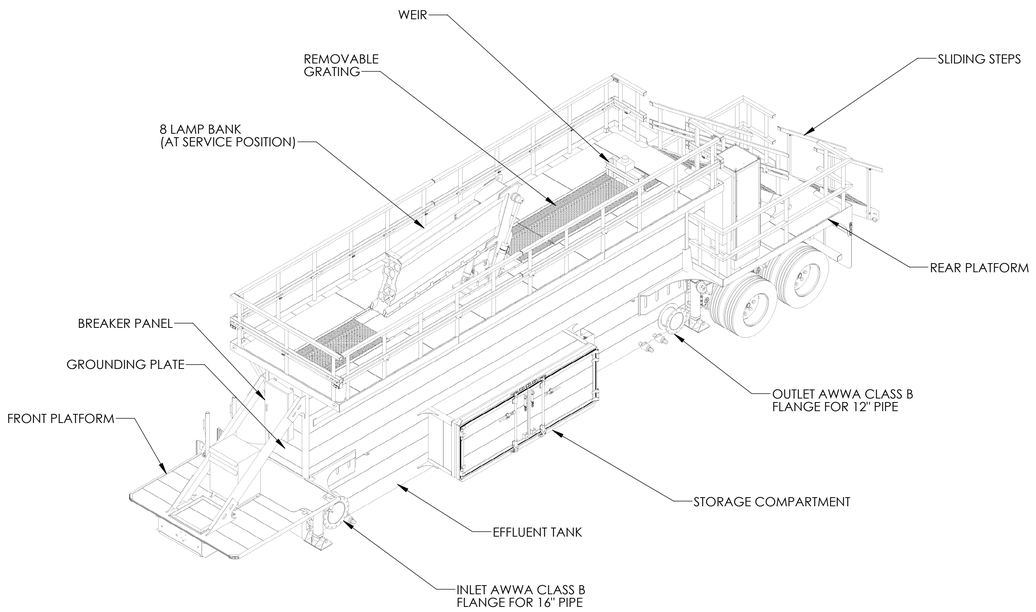
A. The following instructions shall be provided:
   1. Dimensions and Layout drawing
   2. Installation requirements

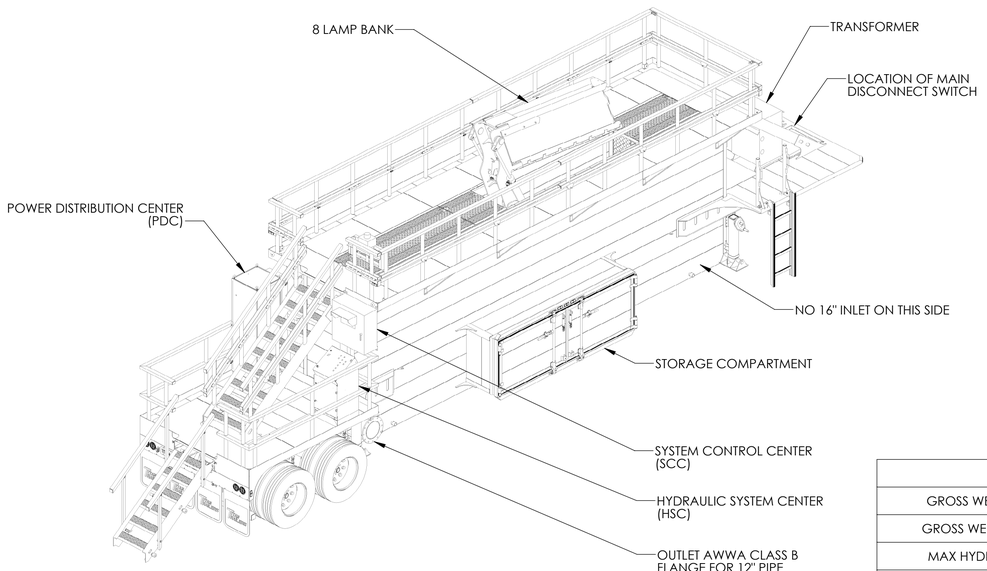
**END OF SECTION 46 66 56**

# APPENDICES

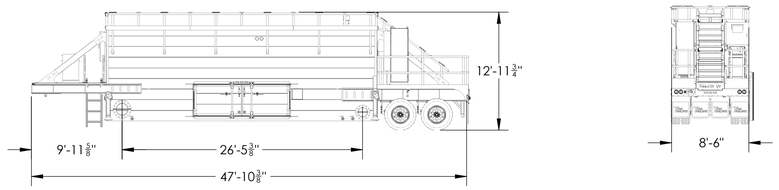
# APPENDIX A

| REV | SHT | ZONE | REVISION DESCRIPTION | LOG NO. | REV BY | CHK BY | APPD BY | DATE YYYY-MM-DD |
|---|---|---|---|---|---|---|---|---|
| 0 | | | DRAWING RELEASED | | XC | | | |

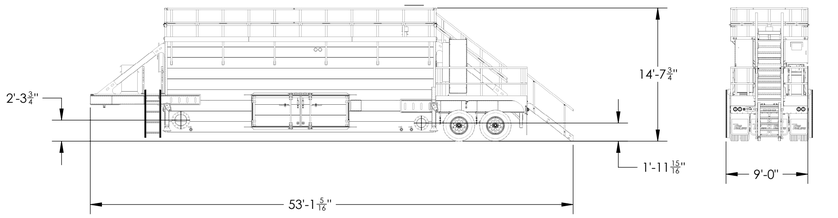


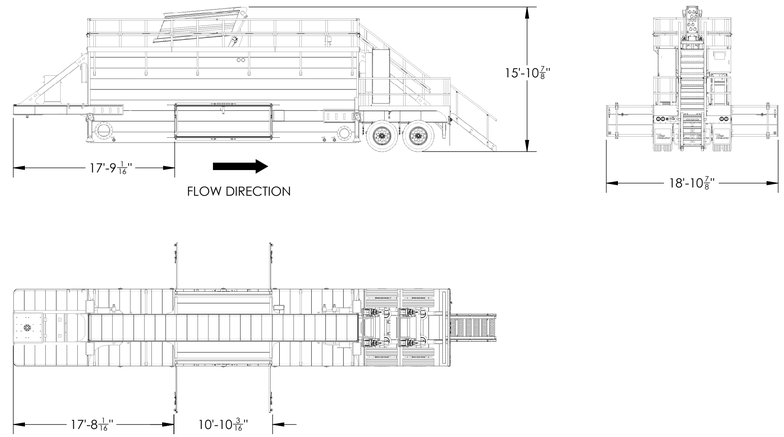

## TOWING DIMENSION




## DISINFECTING DIMENSION




## SERVICING DIMENSION




| GENERAL SPECIFICATION | |
|---|---|
| GROSS WEIGHT (NO WATER) | 20,000LBS |
| GROSS WEIGHT (FULL WATER) | 72,000LBS |
| MAX HYDRAULIC CAPACITY | 8 MGD |
| HEADLOSS (INCH) | 7 @ 8MGD |
| EFFLUENT TANK CAPACITY | 6260 GALLON |
| | |
| **ELECTRICAL SPECIFICATION** | |
| INPUT VOLTAGE | 480VAC 3PH |
| MAX. POWER REQUIRED | 50 KVA |
| MAIN DISCONNECT | RATED 100 AMP FUSED 75 AMP |

NOTES

- PARKING GROUND TO BE ASPHALT OR HARD PACKED GRAVEL, NO GRASS AND LEVEL.
- REFER TO OPERATIONAL PROCEDURE.
- FOLLOW ALL SAFETY REQUIREMENT.
- TRAILER TO BE GROUNDED AS PER LOCAL CODE REQUIREMENT.

**UNLESS OTHERWISE SPECIFIED:** DO NOT SCALE DRAWING
INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
DIMENSIONS ARE IN INCHES
TOLERANCES APPLY AS SHOWN BELOW:
2 PL DEC ± 0.01
3 PL DEC ± 0.005
ANGLE ± 1.0
REMOVE ALL BURRS. ALL CORNERS R 0.010" OR BREAK EDGE. CRITICAL CHARACTERISTIC
THIRD ANGLE PROJECTION



**SolidWorks** MAINTAINED DATA CHANGES SHALL BE INCORPORATED ELECTRONICALLY

DRAWN BY: XC
CREATED ON: 2012-07-05
RELEASE LOG #:

TROJAN UV
3020 GORE RD, LONDON, ONTARIO, CANADA, N5V-4T7

DESCRIPTION: TRAILER LAYOUT, UV SIGNA

DWG NO.: DR8930300S01
REV: 0
MASS: 58675.95 lbs | SCALE 1:100 | SHEET 1 OF 1 | SIZE D

CURRENT STATUS: NOT VAULTED

# Trojan UV3000TMPLUS – Pilot Unit

# Installation Instructions

**NOTE**: The purpose of the installation instructions for the UV3000TMPLUS pilot is to provide sufficient detail to safely install the system.

## Table of Contents

# 1. Overview

The mobile pilot is shipped on a roll top flat bed trailer and can be off loaded using a crane or fork truck. The unit must be placed on a level surface. The pilot unit footprint is approximately 38 x 7 x 8ft. and weighs approximately 10000lbs when pumping effluent.

The unit has one (1) channel, with inlet and outlet transition boxes at either end, one (1) Power Distribution Panel (PDP) two (2) Power Distribution Center (PDC) and one (1) Hydraulic System Center (HSC). There is also a System Control Center (SCC) that is located beside the unit where overall system control will take place.

The unit itself features one (1) bank of low-pressure high intensity lamps in a stainless steel channel. The unit also contains Trojan's automatic chemical/mechanical cleaning system. This unit is hydraulically capable of treating up to 2.5 MGD.

The provided SCC and HSC will need to be installed in very close proximity to the inlet box. Refer to the Layout drawing for more detailed info. The PDC's will need to be installed on top of the channel

Trojan Technologies will provide the following equipment.

One (1) UV3000Plus channel
One (1) Flow meter 10" flanged
One (1) System Control Center
Two (2) Power Distribution Panel
One (1) Hydraulic System Center
One (1) Power Distribution Center
Operational supplies

The contractor will be responsible for the following:
Provide and install pump capable of delivering flows up to 2.5MGD
Pipe work to and from pilot unit

Make the electrical connection from the plant to Trojan's Power Distribution Panel

# 2. Physical Placement of the Pilot Unit and Inlet and Discharge Pipe Work

The System UV3000PLUS™ pilot unit is divided into three (3) main sections.

1. Inlet Chamber
2. Channel
3. Water level control section
4. Outlet or Discharge chamber.

**NOTE:** Please carefully remove all wooden crates loaded aside of the pilot unit. One crate contains the quartz sleeves, UV lamps, modules and other support equipment. It should be stored in a secure, cool, dry place until Trojan representatives are on site for final installation work.

The unit must be placed on a level surface both front to back and side to side.

A wooden structure may be built to ensure the pilot unit is positioned level.

## 2-1 Piping Connections to the UV3000™PLUS pilot

The piping regime for the system includes four main activities:

a. Inlet piping (1 connection) (supplied by contractor)
b. Outlet piping (4 connections (supplied by contractor)
c. Flow meter (supplied by Trojan)
d. Submersible Effluent Pump (supplied by contractor)

### 2-1-1 Inlet Pipe Connection Point (1)

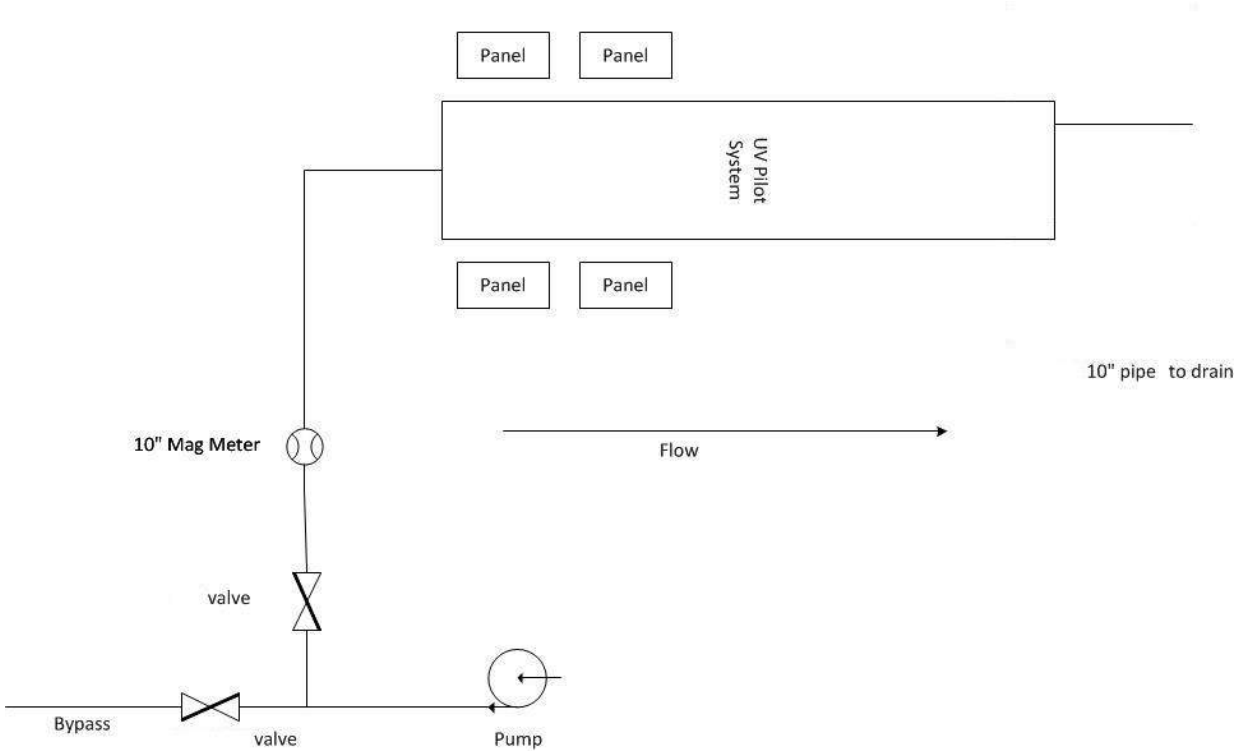
The inlet of the pilot is located at ground level adjacent to the discharge chamber. 10" flanged pipe connections are required.

### 2-1-2 Discharge Pipe Connection Points (4)

The four (4) discharge point is located at the bottom and on available on three (3) sides of the discharge box. Please note that the pilot discharge flows by gravity. In order to prevent back up of effluent and to ensure proper functioning of the level controlling device it will be important to ensure that all discharge lines are plumbed so as to flow continually downward to the final discharge point. The entire pilot unit may need to be installed on a raised lumber frame incase the discharge pipe work has to go over concrete walls/slabs to discharge.

### 2-1-3 Flow meter

Upstream from the inlet chamber the supplied 10" flanged flow meter should be installed. There should be no valves or elbows installed within 10 pipe diameters up stream and downstream from the flow meter.



Recommended pipe layout

# 3. Electrical requirements

The system electrical requirements include:

**UV3000+ Power Distribution Panel**

277/480 Y VAC, 60 Hz
10KVA
3 phase + neutral + ground

Install any wiring from the Power Distribution Panel to the following equipment:

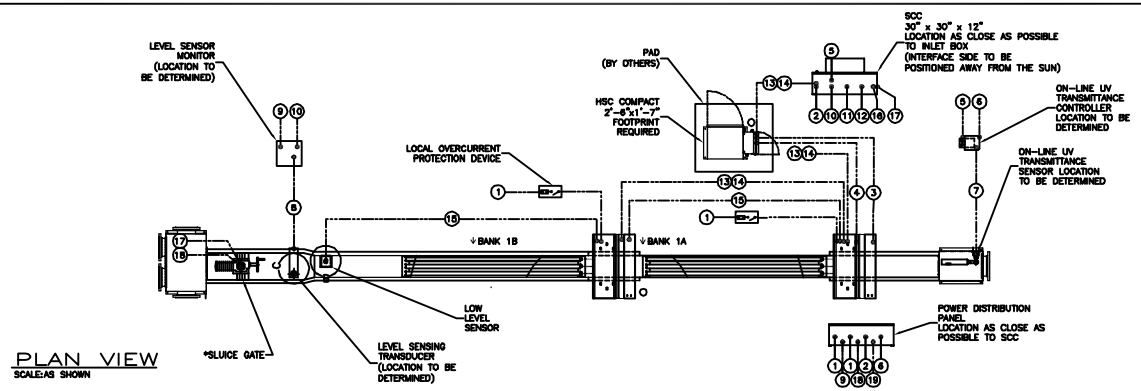
- Flow meter
- System Control Center
- Power Distribution Center and then on to Hydraulic System Centre

Electrical requirements to be finished by qualified electrician supplied by the contractor:

- Power from the plant into the Power Distribution Panel

# 4. Contact Information

Any questions or concerns before or during the installation of the Trojan UV3000PLUS™ pilot unit should be directed to Willem Verhulst, Pilot Project Coordinator at 519-457-2701 ext.2398 (8 am to 4:30pm EST).

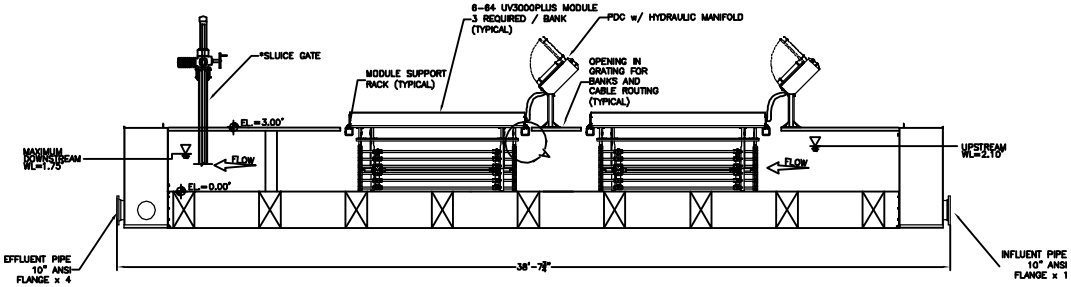


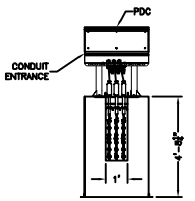

PLAN VIEW
SCALE:AS SHOWN

NOTES:
: DO NOT SLOPE CHANNEL FLOOR.
: CHANNEL WIDTH & DEPTH MUST BE KEPT WITHIN A TOLERANCE OF + OR – ¼".
: ANCHOR BOLTS ARE NOT SUPPLIED BY TROJAN TECHNOLOGIES.
: SYSTEM CONDUIT, WIRING, DISTRIBUTION PANELS & INTERCONNECTIONS BY OTHERS.
: ELECTRICAL REQUIREMENTS SHOWN ARE TO SUPPLY TROJAN UV EQUIPMENT ONLY. ELECTRICAL INRUSH FACTOR TO BE ADDED AS PER LOCAL CODE.
: CONTRACTOR TO REVIEW ALL TROJAN TECHNOLOGIES INSTALLATION INSTRUCTIONS PRIOR TO EQUIPMENT INSTALLATION.
: EFFLUENT LEVELS SHOWN REFLECT HYDRAULICS ASSOCIATED WITH TROJAN EQUIPMENT ONLY. EFFLUENT LEVELS MAY BE ALTERED DUE TO CHANNEL DEBRIS OR GEOMETRY.
: HSC COMPACT IS SUPPLIED WITH A 25' HOSE KIT.
: *EFFECTIVE WEIR LENGTH IS 15"

## TROJAN UV3000 PLUS
EQUIPMENT INTERCONNECTIONS

| No. | DESCRIPTION | FROM | TO |
|---|---|---|---|
| 1 | POWER DISTRIBUTION CENTER (PDC) POWER SUPPLY 480Y/277V, 3 PHASE, 4 WIRE + GROUND 7.1 kVA/PDC POWER DRAW 8.6 MAXIMUM CURRENT/PHASE | POWER DISTRIBUTION PANEL (PDP) | PDC |
| 2 | SYSTEM CONTROL CENTER (SCC) POWER SUPPLY 120 V, 1 PHASE, 2 WIRE + GROUND 15 AMPS | POWER DISTRIBUTION PANEL (PDP) | SCC |
| 3 | HYDRAULIC SYSTEMS CENTER COMPACT (HSC COMPACT) 24 VDC | PDC 1A | HSC COMPACT |
| 4 | HYDRAULIC SYSTEM CENTER COMPACT (HSC COMPACT) POWER SUPPLY 480 V, 3 PHASE, 3 WIRE + GROUND | PDC 1A | HSC COMPACT |
| 5 | ON-LINE UV TRANSMITTANCE CONTROLLER SIGNAL 4-20 mA ANALOG INPUT | ON-LINE UV TRANSMITTANCE CONTROLLER | SCC |
| 6 | ON-LINE UV TRANSMITTANCE CONTROLLER POWER SUPPLY 120 V, 1 PHASE, 2 WIRE + GROUND 1 AMPS | POWER DISTRIBUTION PANEL (PDP) | ON-LINE UV TRANSMITTANCE CONTROLLER |
| 7 | ON-LINE UV TRANSMITTANCE SENSOR COMMUNICATION (SENSOR CABLE PROVIDED BY HACH) | ON-LINE UV TRANSMITTANCE SENSOR | ON-LINE UV TRANSMITTANCE CONTROLLER |
| 8 | COMMUNICATION LINK 30ft CABLE PROVIDED BY TROJAN | LEVEL SENSING TRANSDUCER | LEVEL SENSOR MONITOR |
| 9 | LEVEL SENSOR POWER SUPPLY 120 V, 1 PHASE, 2 WIRE + GROUND 15 VA | POWER DISTRIBUTION PANEL (PDP) | LEVEL SENSOR MONITOR |
| 10 | WATER LEVEL SENSING 4-20 mA ANALOG INPUT SIGNAL | LEVEL SENSOR MONITOR | SCC |
| 11 | ETHERNET/IP COMMUNICATION CAT5 CABLE CONNECTION RJ45 | SCC | PLANT SCADA (BY OTHERS) (NOT SHOWN) |
| 12 | FLOW METER 4-20 mA, DC ANALOG INPUT | FLOW METER PANEL (NOT SHOWN) | SCC |
| 13 | GROUND LINK 14 AWG TYPE THW STRANDED | SCC | PDC & HSC COMPACT (DAISY CHAINED) |
| 14 | MODBUS 1 SHIELDED TWISTED PAIR | SCC | PDC & HSC COMPACT (DAISY CHAINED) |
| 15 | DISCRETE LOW LEVEL SIGNAL 12 VDC – 2 CONDUCTORS | LOW LEVEL SENSOR | PDC(S) DAISY_CHAINED |
| 16 | POWER DISTRIBUTION PANEL (PDP) POWER SUPPLY 480Y/277V, 3 PHASE, 4 WIRE + GROUND | SCC | POWER DISTRIBUTION PANEL |
| 17 | OPEN COMMAND DISCRETE OUTPUT (MIN 20 AWG) – 2 CONDUCTORS<br>CLOSE COMMAND DISCRETE OUTPUT (MIN 20 AWG) – 2 CONDUCTORS<br>GATE IN REMOTE MODE DISCRETE INPUT (MIN 20 AWG) – 2 CONDUCTORS<br>GATE FAULT DISCRETE INPUT (MIN 20 AWG) – 2 CONDUCTORS<br>GATE POSITION ANALOG INPUT 4-20mA 1 TWISTED SHIELED PAIR (24 AWG) | SCC<br>SCC<br>WEIR GATE<br>WEIR GATE<br>WEIR GATE | WEIR GATE<br>WEIR GATE<br>SCC<br>SCC<br>SCC |
| 18 | WEIR GATE POWER SUPPLY 480V, 3 PHASE, 3 WIRE + GROUND | POWER DISTRIBUTION PANEL (PDP) | WEIR GATE |
| 19 | POWER SUPPLY 480Y/277V, 3 PHASE, 4 WIRE + GROUND 10KVA | PLANT MCC (BY OTHERS) (NOT SHOWN) | POWER DISTRIBUTION PANEL |




| DESIGN CRITERIA | | |
|---|---|---|
| | PEAK FLOW | 3.0 MGD |
| | U.V TRANSMITTANCE AT 253.7 nm | |
| | SUSPENDED SOLIDS | |
| | DISINFECTION STANDARD | 200 FC/100ml 30 DAY GEO MEAN<br>400 FC/100ml 7 DAY GEO MEAN |

TROJANUV



DESCRIPTION: LAYOUT, UV3000PLUS PILOT UNIT A

| | | |
|---|---|---|
| DRAWN BY : DTR/CJB | DATE : | |
| CHECKED BY : DTR | DATE : | |
| APPROVED BY : DP | DATE : | |
| SCALE (11x17) : 3/16" = 1'0" | LOG NUMBER : N/A | |

QUOTE NO.
PROJECT NO.
DWG NO. S01
REV. C

TROJAN TECHNOLOGIES

# Trojan UVSigna Pilot

# Installation Guide

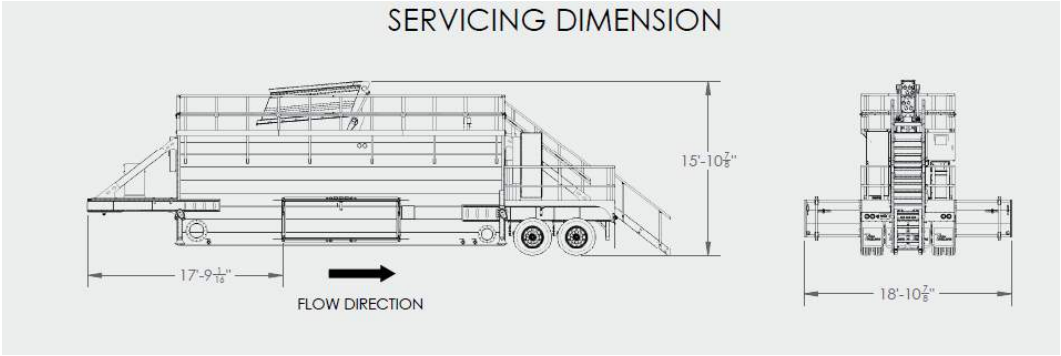
# Trojan UV Signa Installation Guide

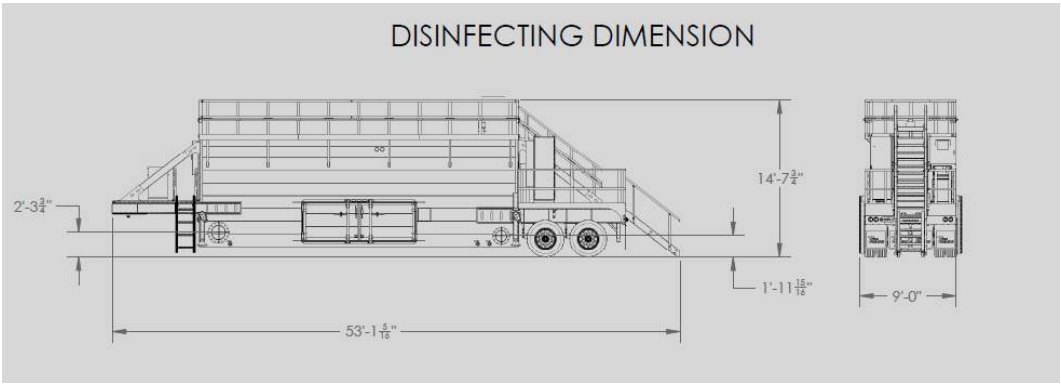


3020 Gore Road
London, ON  N5V4T7
Phone 519.457.3400 • Fax 519.457.3030

# Table of Contents





The purpose of the installation instructions for the UVSigna pilot is to provide sufficient detail to safely install the system

# 1. Overview

The mobile pilot is permanently installed on a flatbed trailer. The unit must be placed on a level surface. The pilot unit footprint is 53' 1 1/16" x 19' with storage doors open. The unit weighs approximately 72,000lbs.when pumping effluent and should not be parked on grass or soil. Parking ground should be asphalt or hard packed gravel and level.

The unit has one (1) channel, with inlet and outlet transition boxes at either end, one (1) Power Distribution Center (PDC), one(1) Hydraulic System Center (HSC). There is also a System Control Center (SCC) from where the overall system control will take place. All items are permanently mounted on the trailer

The unit itself features one (1) bank of eight (8) Trojan Solo lamps in a stainless steel channel. The unit also contains Trojan's automatic chemical/mechanical cleaning system. This unit is hydraulically capable of treating up to 8 million gallons per day.

Only one (1) electrical connection is required to power up the entire unit. All panels and control centers are permanently wired.

# 2. Parking and Landing Gear

The trailer shall be parked on a level surface. Once the trailer is in its final place the four (4) landing gears should be extended. Each landing gear has its own level. Ensure the trailer is level. Observe maximum height and allow ample space around the trailer for ladder at the back and doors from the storage compartment on the side of the trailer. Refer to Trojan UVSigna Layout drawing for more information.

Landing gear and levels

## 3. Electrical Requirements

Plant power shall be connected by local qualified electrician directly to the Main Disconnect mounted on the front deck of the UV trailer. Power requirements are as follows:

**480 Volt AC**
**60 Hertz**
**3 Phase + ground**
**50 KVA**

Main Disconnect is fused at 75 Amps. Trojan Technologies will provide a ground plate, which shall be installed at least 30 inches below grade. Ground plate shall be connected through ground wire, not smaller than 6 AWG and terminated at the terminal block located on the front of the trailer near the Main Disconnect. A ground rod near the trailer is also acceptable

Main Disconnect located at front of trailer

## 4. Inlet and Discharge Pipe Connections

One (1) 16” inlet AWWA Class B Flange located near the front of the trailer (see Trojan UVSigna layout drawing) shall be connected to a pump and Flow meter. It is recommended to install a Bypass Tee upstream of the flow meter to better control the flow through the pilot system. The surplus flow will then be diverted back to where the pump draws from.

Two (2) 12” outlet AWWA Class B flanges located near the back end of the trailer shall be used for gravity discharge.

## 5. Flow meter

One (1) 16” flow meter is provided for the use of capturing flow data during the pilot project. The Flow meter is temporarily mounted at the front deck of the trailer and can be lifted off and removed for installation at inlet by fork truck or

crane. The weight is approximately 300lbs. A minimum of five (5) pipe diameters upstream and two (2) pipe diameters downstream of any valves, reducers, tees or elbows etc. as specified by the flow meter manufacturer shall be observed. A grounding ring is also provided by Trojan and shall be installed at the flow meter with gaskets. Trojan will provide power and 4-20mA wiring. Flow direction shall be as indicated on the flow meter.

Flow meter with grounding ring

# 6. Recommended Piping Schematic