VOLUME II -
TECHNICAL SPECS ONLY
CONTRACT DOCUMENTS AND SPECIFICATIONS

for

# Killian Creek WWTP Upgrade Phase 3

November 2018
WKD # 20170294.00.CL

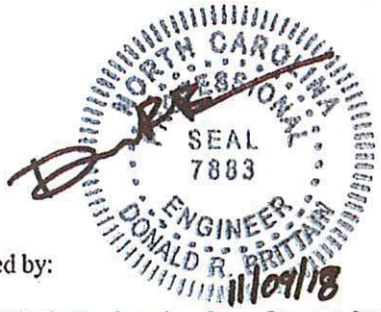
**CWSRF Project No. CS 370825-02**


Prepared for

Lincoln County
115 West Main Street
Lincolnton, NC 28092

FINAL DESIGN

**NOT RELEASED FOR CONSTRUCTION**



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Lincoln County, North Carolina
Killian Creek Phase WWTP Upgrade Phase 3
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**VOLUME II**

**TECHNICAL SPECIFICATIONS**

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SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Contract description.
2. Specification Conventions.
3. Contractor's use of site and premises.
4. Work sequence.
5. Owner occupancy.

1.2 CONTRACT DESCRIPTION

A. Base Bid:
Work of the Project within the Base Bid includes the following equipment additions and associated construction services for the upgrade to the Lincoln County Killian Creek WWTP Upgrade Phase 3:
1. New influent headworks, Sequencing Batch Reactor System (SBR) flow splitter and related slide gates and electric actuators.
2. New SBR, Post Equalization, Aerobic Digester and Sludge Holding Tank System including concrete basin structure, blowers, jet aeration mixers, sludge transfer pumps, and related controls incorporating the existing SBR system into a four (4) SBR basin system.
3. Modifications to existing SBR system to include changeout of existing blowers sheaves to increase blower speed and capacity, modifications to influent flow splitter/electrically actuated gates, addition of influent drop boxes and diffuser pipes in each SBR basin and modification to existing SBR control system to integrate controls into the new SBR control system.
4. New Effluent Filters Building with two (2) new effluent disk filters and three (3) relocated existing disk filters and related controls.
5. New effluent Ultraviolet (UV), dual channel disinfection system installed in existing effluent building with related controls and building modifications.
6. New waste activated sludge (WAS) sludge thickener and related sludge transfer pumps, polymer feed system, piping and controls.
7. Modifications to existing RTD sludge building to add a hot water tank and tepid eye wash and safety shower.
8. New sludge pump station including sludge grinder, rotary lobe pumps and related transfer piping and controls.
9. New sludge dewatering building including two (2) new rotary sludge filter presses, polymer feed systems, sludge conveyors and related controls.
10. New caustic chemical feed pumps capable of caustic addition to the new SBR tanks and digesters.
11. New chemical feed system associated with phosphorus removal including storage tank, recirculation pump and chemical metering pumps and controls.
12. Related site grading, storm water drainage, erosion/sediment control, site piping and roads.

B. Unit Cost Items – N/A

C. Contingency Allowance – N/A

D. Permits – The North Carolina Division of Environmental Quality has issued an "Authorization to Construct" for the project. The Contractor shall be responsible for the Lincoln County Building Permits for all trades with the associated cost as follows:

| | | |
|---|---|---|
| 1. | Plan Review | $ TBD |
| 2. | Building Fee | $ TBD |
| 3. | Zoning Fee | $ TBD |
| 4. | Erosion Control | $ TBD |

The related Building Permit Application will be submitted by the Owner but fees are to be paid by the Contractor prior to beginning construction.

1.3 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

B. "NIC" (Not in Contract) indicates items that are to be furnished and installed by the Owner or other contractors selected by the Owner at a later date.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. The Contractor will be allowed access to the site during operational hours corresponding to the wastewater treatment plant operation or prior scheduled with the Owner.

B. All work associated with the renovations shall be performed in a manner such that there will be no impact to the existing wastewater treatment operations or performance.

C. All work requiring utility outages of shutdown will be limited and must be scheduled with the Owner in advance.

D. The initial contract period is to be utilized for shop drawing submittals and approvals and other non-site related work and the field construction work at the Killian Creek WWTP site to be limited to the contract period noted in the Agreement C-520.

1.5 WORK SEQUENCE

A. Construction work to be performed and coordinated with the Owner's WWTP Operations Staff to maintain treatment operations at all times.

1. Construction services related to the new headworks, SBR flow splitter, SBR/aerobic digesters system, blower building, sludge thickener, sludge pump station and sludge dewatering system and the related site work that does not impact the existing treatment process may be performed per the Contractors schedule without impact to the existing system operation.
2. As the various new headworks, SBR, Post EQ, digesters and SHT structures are completed, leakage testing shall be performed utilizing the existing SBR effluent

or purchased potable water. SBR effluent may be obtained at the existing Post EQ basin with the Contractor providing all necessary temporary pumps and piping for the transfer to the new basins and related transfers. Upon completion of the testing, the test water shall be released to the plant drain at a rate approved by plant operations for retreatment or incorporated into the new system startup.

3. Work associated with the new effluent filter building shall be performed in a manner to minimize impact to the existing plant operation. The new building including installation and startup of the two (2) new effluent disk filters shall be completed prior to initiating the relocation of the existing filters. During the relocation of the existing filter units, the relocation shall be scheduled such that a minimum of three (3) new and existing effluent filters are operable at all times.
4. Modification of the existing Effluent/UV building for the installation of the new UV disinfection system shall be delayed until the new effluent filter system with all relocated existing filters is operational. The existing UV disinfection system shall remain operable throughout the modification work to the UV building for the installation of the new UV channels. In the event of a required power outage, temporary provisions for power shall be provided.

All modifications to the existing SBR system requiring drainage of a SBR basin or removal of the SBR basin or post-equalization basins from service shall be scheduled after the complete startup, checkout and placement of the new SBR system into acceptable operation.

1.6 OWNER OCCUPANCY

A. The Owner will occupy the site and facilities during the entire period of construction for the conduct of normal operations. All of the new equipment components installations can be completed, checked out with final placement into operation held until approval from the North Carolina Department of Environment and Natural Resources (NCDENR) is received. Any areas where work requires acceptance and placement of components of the wastewater treatment plant renovations into service as completed will necessitate close communication with the Owner, Engineer and partial approvals to operate from NCDENR.

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

C. Schedule the Work to accommodate Owner occupancy.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Schedule of values.

B. Applications for payment.

C. Change procedures.

D. Defect assessment.

E. Unit prices.

F. Alternates.

G. Cash allowances.

H. Testing and inspection allowances.

### 1.2 SCHEDULE OF VALUES

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

B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.

C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify site mobilization, bonds and insurance.

D. Include in each line item, amount of Allowances specified in this Section. For unit cost allowances, identify quantities taken from Contract Documents multiplied by unit cost to achieve total for each item.

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

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

### 1.3 APPLICATIONS FOR PAYMENT

A. Submit three copies of each application on the Contractor’s standard form or other approved form. Contractor's electronic media driven form will be considered.

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

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

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

E. Submit with transmittal letter as specified for Submittals in Section 01 33 01 - Submittal Procedures EPMS.

F. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Current construction photographs specified in Section 01 33 01.
   2. Partial release of liens from major subcontractors and vendors.
   3. Record documents as specified in Section 01 70 00, for review by Owner which will be returned to Contractor for all work and material included in pay request.
   4. Affidavits attesting to off-site stored products.
   5. Construction progress schedules, revised and current as specified in Section 01 33 01.

1.4 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. The Engineer will advise of minor changes in the Work not involving adjustment to Contract Price or Contract Time by issuing supplemental instructions.

C. The Engineer may issue a Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 15 days.

D. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section EJCDC® C-200 – Instructions to Bidders.

E. Stipulated Price Change Order: Based on Notice of Change and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Engineer.

F. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute Work under Work Change Directive. Changes in

Contract Price or Contract Time will be computed as specified for Time and Material Change Order.

G. Work Change Directive: Engineer may issue directive, signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Price or Contract Time. Promptly execute change.

H. Force Account Change Order: Submit itemized account and supporting data after completion of change within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Price and Contract Time as provided in Contract Documents.

I. Maintain detailed records of work done on Force Account basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.

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

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

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

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but price will be adjusted to new price at discretion of Owner.

D. Defective Work will be partially repaired to instructions of Owner, and unit price will be adjusted to new price at discretion of Owner.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Engineer to assess defects and identify payment adjustments is final after Owner Approval.

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

1.6 UNIT PRICES

A. Authority: Measurement methods are delineated in individual Specification Sections.

B. Measurement methods delineated in individual Specification Sections complement criteria of this Section. In event of conflict, requirements of individual Specification Section govern.

C. Engineer or Owner will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.

D. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Actual quantities provided shall determine payment.
   1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.

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

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

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

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

H. Unit Price Schedule: Refer to Bid Form.

1.7 ALTERNATIVE EQUIPMENT

A. An addition or deduct to the Base Bid Price for "Alternative Owner Preferred Equipment or Product" is to be provided in the Bid. Following the bid and consideration of costs, the Owner will review costs and decide which if any of the Owner preferred equipment and products to accept with the final contract price to be adjusted accordingly.

1.8 CASH ALLOWANCES

A. A cash allowance is to be provided on the bid form for the retainage of the Owner's SCADA subcontractor and installation of the SCADA equipment. The Contractor shall invoice the Owner these costs as part of the project cost without markup.

1.9 TESTING AND INSPECTION

A. Cost of engaging testing and inspecting agency; execution of tests and inspecting; and reporting results associated with items constructed and installed are the responsibility of the Contractor with all costs included in the contract price.

B. Costs of required inspections associated with site building shall be the responsibility of the Owner/Engineer at no Cost to the Contractor.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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SECTION 01 22 01
ELECTRONIC PROJECT MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section describes the requirements for the Electronic Project Management System (EPMS).

1.2 RELATED DOCUMENTS

A. Agreement Form Section EJCDC® C-520.

1.3 SCOPE

A. Engineer will implement an internet/web site based Electronic Project Management System (EPMS) for the project. Contractors will be responsible to interface with EPMS and provide information via EPMS. A high speed internet connection is required. In general, the EPMS will receive input, provide viewing and printing of various documents (which may include drawings and technical information) and be a central repository for information to all project team members.

B. The EPMS web site will be provided by Engineer. Contractor and all Subcontractors will be required to have a high speed internet connection.

C. The EPMS will be designed to inform team members regarding new or updated documents. The following items shall be entered and tracked online:
1. Request for Information (RFI)
2. Supplemental Instructions
3. Submittals (shop drawings)
4. Change Orders
5. Pay Requests
6. Reports (daily, monthly, etc.)
7. Schedules
8. Special Inspections
9. Closeout procedures (punch list, warranty)
10. Operations & Maintenance Manuals

D. Email is expected to be a primary communications tool between Engineer and project team members who upload information to EPMS.
1. In an effort to protect proprietary information and prohibit unauthorized use or modifications, levels of access security will be assigned by Engineer. Prints of drawings and the associated costs for reproduction and distribution by the Engineer is not part of the Work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 TRAINING

A. One training session by the Engineer to the team members at the beginning of the EPMS implementation will be provided. Additional training expenses will be borne by the Contractor, as needed.

3.2 SUPPORT

A. Will be available to all project team members.

3.3 OPERATION

A. Contractor and all Subcontractors shall maintain a Windows-based computer system including high speed internet access and ability to create/mark-up documents using Adobe Acrobat (pdf) and to scan documents. Engineer's vendor shall maintain the EPMS server and back-up the information.

3.4 DURATION

A. Web site will be active during the construction. Owner will have option to continue use the web site after the completion of the project.

3.5 ARCHIVE

A. All files on the web site will be archived at the end of the project. These archives will be made available to the various Contractors for download over the internet, at their expense/labor.

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination.

B. Field engineering.

C. Preconstruction meeting.

D. Progress meetings.

E. Pre-installation meetings.

F. Cutting and patching.

1.2 COORDINATION

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

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

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

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

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

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

## 1.3 FIELD ENGINEERING

A. Employ Land Surveyor license in North Carolina.

B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.

C. Control datum for survey is that indicated on Drawings.

D. Submit copy of an as-built survey sealed and signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

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

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

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

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

## 1.4 PRECONSTRUCTION MEETING

A. Owner will schedule meeting after Contract is fully executed.

B. Attendance Required: Owner, Engineer, and Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
5. Designation of personnel representing parties in Contract, Engineer, independent testing firm.
6. Procedures and processing of field decisions, submittals, and substitutions, applications for payments, proposal requests, Change Orders, and Contract closeout procedures.
7. Scheduling.

D. Engineer will record minutes and distribute copies electronically within two days after meeting Owner, Contractor, and those affected by decisions made.

## 1.5 PROGRESS MEETINGS

A. Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings and administer meetings.

B. Schedule: Throughout progress of the Work at maximum interval of monthly. Meet more often if Work dictates need.

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

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

E. Engineer will record minutes and distribute copies electronically within three days after meeting to Owner, Contractor, and those affected by decisions made.

## 1.6 PRE-INSTALLATION MEETINGS

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

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

C. Notify Engineer four days in advance of meeting date.

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

E. Record minutes and distribute copies electronically within two days after meeting to Owner, and those affected by decisions made.

## PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

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

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

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

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

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

F. Cut pavements using concrete saw.

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

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

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

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

K. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to maintain original fire rating.

L. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

END OF SECTION

SECTION 01 33 01
SUBMITTAL PROCEDURES EPMS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Submittal procedures.
2. Product data.
3. Shop drawings.
4. Samples.
5. Design data.
6. Test reports.
7. Certificates.
8. Manufacturer's instructions.
9. Manufacturer's field reports.
10. Construction progress schedules.
11. Proposed products list.
12. Erection drawings.

### 1.2 SUBMITTAL PROCEDURES

A. Submit via Electronic Project Management System (EPMS).

B. For each submittal for review, allow 21 days.

C. Upload each submittal separately.

D. Sequentially number. Mark revised submittals with original number and sequential alphabetic suffix.

E. Identify Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.

F. Apply Contractor's stamp signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

G. Schedule submittals to expedite Project. Coordinate submission of related items.

H. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

I. Allow space on submittals for Contractor and Engineer review stamps.

J. When revised for resubmission, identify changes made since previous submission.

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

L. Submittals not requested will not be recognized or processed.

1.3 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Mark submittal to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.4 SHOP DRAWINGS

A. Shop Drawings: Submit to Engineer (via EPMS) for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual specification sections, provide shop drawings signed and sealed by North Carolina professional engineer responsible for designing components shown on shop drawings.
   1. Include signed and sealed calculations to support design.
   2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
   3. Make revisions and provide additional information when required by authorities having jurisdiction.

1.5 SAMPLES

A. Samples: Email Engineer for avenue of submittal and quantity. e.g. EPMS, physically shipped to Engineer or constructed on site for appropriate approval. Submit for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit number of samples communicated by Engineer.

C. Samples For Selection as Specified in Product Sections:
   1. Submit to Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturers' standard colors, in custom colors selected, textures, and patterns for Engineer selection and Owner approval.

D. Submit samples to illustrate functional and aesthetic characteristics of Products with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

E. Include identification on each sample with full Project information.

F. Reviewed samples which may be used in the Work are indicated in individual specification sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

H. After review, produce duplicates and distribute (if appropriate based on method of submission) in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00 - Execution and Closeout Requirements.

1.6 DESIGN DATA

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.7 TEST REPORTS

A. Submit for Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

A. When specified in individual specification Sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Engineer.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product but must be acceptable to Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification Sections, submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing to Engineer for delivery to Owner.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.10 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Engineer's knowledge as contract administrator or for Owner.

B. Submit report within 72 hours of observation to Engineer for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.11 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within 10 days.

B. Submit revised Progress Schedules with each Progress Meeting or Application for Payment, but not less than monthly.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar or Gantt chart with separate line for each major portion of Work or operation, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Submit separate schedule of submittal dates for shop drawings, product data, and samples. Indicate dates reviewed submittals will be required from Engineer. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products and products identified under Allowances if required.

J. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, including effect of changes on schedules of separate contractors.

1.12 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.13 ERECTION DRAWINGS

A. Submit drawings for Engineer's knowledge as contract administrator or for Owner.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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SECTION 01 40 00
QUALITY REQUIREMENTS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Quality control and control of installation.
2. Tolerances.
3. References.
4. Testing and inspection services.
5. Manufacturers' field services.
6. Labeling.
7. Mock-up requirements.
8. Examination.
9. Preparation.

### 1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

### 1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

## 1.4 REFERENCES

A. For products or Work specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving Bids, (date of Owner-Contractor Agreement when there are no Bids), except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. Notify Engineer and Owner of conflicts with standards at time of Bid.

E. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

F. Contractual relationships, duties, and responsibilities of parties in Contract and those of Engineer shall not be altered from Contract Documents by mention or inference otherwise in reference documents.

## 1.5 TESTING AND INSPECTION SERVICES

A. Contractor shall employ and pay for services of an independent firm acceptable to Owner to perform specified testing and inspection.
   1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered North Carolina Engineer, specialists and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

B. Independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Engineer.
   1. Laboratory: Authorized to operate in State of Project location.
   2. Laboratory Staff: Maintain full time registered Engineer and necessary specialists on staff to review services.
   3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

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

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and independent firm 24 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

E. Testing and employment of independent firm does not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

F. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Engineer.
   1. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
   2. Submit final report indicating correction of Work previously reported as non-compliant.

G. Independent Firm Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings.

H. Independent Firm Reports: After each test, promptly submit one electronic copy of report to Engineer and Owner, Contractor, and authority having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Results of tests.
   10. Conformance with Contract Documents.

I. Limits On Independent Firm:
   1. May not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. May not approve or accept any portion of the Work.
   3. May not assume duties of Contractor.
   4. Has no authority to stop the Work.

1.6 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to:
   1. Observe site conditions.
   2. Observe conditions of surfaces.
   3. Review installation and quality of Work.
   4. Review start-up of equipment.
   5. Review testing, adjusting and balancing of equipment.
   6. Initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.7 LABELING

A. Attach label from agency approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

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SECTION 01 43 13
REFERENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Quality assurance.
   2. Schedule of references.

1.2 RELATED SECTIONS

A. Document – General Conditions: Reference Standards.

1.3 QUALITY ASSURANCE

A. For products or workmanship specified by association, trades, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
   1. Applicable Codes:
      a. BOCA National Building Code.
      b. The National Electrical Code, NFPA 70.
      c. The Life Safety Code, NFPA 101.

B. Obtain copies of standards when required by product specification sections.

C. Maintain copy at jobsite during submittals, planning, and progress of the specific work, until Substantial Completion.

D. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.4 SCHEDULE OF REFERENCES

**AA**
Aluminum Association
900 19th St., NW
Washington, DC 20006
www.aluminum.org
(202) 862-5100

**AABC**
Associated Air Balance Council
1518 K St., NW
Washington, DC 20005
www.aabchq.com
(202) 737-0202

**AAMA**
American Architectural Manufacturers Association
1827 Walden Office Sq., Suite 104
Schaumburg, IL 60173-4268
www.aamanet.org
(847) 303-5664

**AASHTO**
American Association of State Highway and Transportation Officials
444 North Capitol St., NW, Suite 249
Washington, DC 20001
www.aashto.org
(202) 624-5800
(800) 231-3475

**ABMA**
American Bearing Manufacturers Association
1200 19th St., NW, Suite 300
Washington, DC 20036-2422
www.abma-dc.org
(202) 429-5155

**ACGIH**
American Conference of Governmental Industrial Hygienists
1330 Kemper Meadow Dr. Suite 600
Cincinnati, Ohio 45240
www.acgih.org
(513) 742-2020

**ACI**
American Concrete Institute
P.O. Box 9094
Farmington Hills, MI 48333
www.aci-int.org
(248) 848-3700

**ADC**
Air Diffusion Council
104 South Michigan Ave., Suite 1500
Chicago, IL 60603
(312) 201-0101

**ADSC**
The International Association of Foundation Drilling
9696 Skillman Street, Suite 280
Dallas, TX 75243
www.adsc-iafd.com
(214) 681-5994

**AF&PA**
American Forest and Paper Association
1111 19th St., NW, Suite 800
Washington, DC 20036
www.afandpa.org
(202) 463-2700

**AHA**
American Hardboard Association
1210 W. Northwest Hwy
Palatine, IL 60067
(847) 934-8800

**AI**
Asphalt Institute
Research Park Drive
P.O. Box 14052
Lexington, KY 40512-4052
www.asphaltinstitute.org
(606) 288-4960

**AISC**
American Institute of Steel Construction
One East Wacker Dr., Suite 3100
Chicago, IL 60601-2001
www.aisc.org
(312) 670-2400

**AISI**
American Iron and Steel Institute
1101 17th St., NW, Suite 1300
Washington, DC 20036
www.steel.org
(202) 452-7100
(800) 277-3850

**AITC**
American Institute of Timber Construction
7012 S. Revere Pkwy, Suite 140
Englewood, CO 80112
www.aitc-glulam.org
(303) 792-9559

**AMCA**
Air Movement and Control Association International, Inc.
30 W. University Dr.
Arlington Heights, IL 60004-1893
www.amca.org
(847) 394-0150

**ANSI**
American National Standards Institute
1819 L. Street, N.W.
Washington, DC 20036
www.ansi.org
(202) 293-8020

**APA/EWA**
APA-The Engineered Wood Association
P.O. Box 11700
Tacoma, WA 98411-0700
www.apawood.org
(253) 565-6600

**API**
American Petroleum Institute
1220 L St., NW
Washington, DC 20005-4070
www.api.org
(202) 682-8000

**AREMA**
American Railway Engineering and
Maintenance-of-Way Association
8201 Corporate Drive, Suite 1125
Landover, MD 02785-2230
www.arema.org
(301) 459-3200

**ARI**
Air-Conditioning and Refrigeration Institute
4301 Fairfax Dr., Suite 425
Arlington, VA 22203
www.ari.org
(703) 524-8800

**ARRA**
Asphalt Recycling and Reclaiming Association
#3 Church Circle, PMB 250
Annapolis, MD 21401
www.arra.org
(410) 267-0023

**ASCE**
American Society of Civil Engineers
World Headquarters
1801 Alexander Graham Bell Dr.
Reston, VA 20191-4400
www.asce.org
(800) 548-2723
(703) 295-6300

**ASHRAE**
American Society of Heating, Refrigerating and Air-Conditioning Engineers
1791 Tullie Circle, NE
Atlanta, GA 30329
www.ashrae.org
(800) 527-4723
(404) 636-8400

**ASME**
American Society of Mechanical Engineers
3 Park Ave.
New York, NY 10016-5990
www.asme.org
(800) 843-2763

**ASSE**
American Society of Sanitary Engineering
901 Canterbury, Suite A
Westlake, OH 44145
www.asse-plumbing.org
(440) 835-3040

**ASTM**
ASTM International
100 Barr Harbor Dr.
West Conshohocken, PA 19428-2959
www.astm.org
(601) 832-9585

**AWI**
Architectural Woodwork Institute
1952 Isaac Newton Sq. West
Reston, VA 20190
www.awinet.org
(703) 733-0600

**AWPA**
American Wood-Preservers' Association
P.O. Box 5690
Granbury, TX 76049
www.awpa.com
(817) 326-6300

**AWS**
American Welding Society
550 NW LeJeune Rd.
Miami, FL 33126
www.amweld.org
(800) 443-9353
(305) 443-9353

**AWWA**
American Water Works Association
6666 W. Quincy Ave.
Denver, CO 80235
www.awwa.org
(303) 794-7711

**BAAQMD**
Bay Area Air Quality Management District
939 Ellis St.
San Francisco, CA 94109
www.baaqmd.gov
(417) 771-6000

**CDA**
Copper Development Association Inc.
260 Madison Ave., 16th Floor
New York, NY 10016
www.copper.org
(800) 232-3282
(212) 251-7200

**CGA**
Compressed Gas Association
1725 Jefferson Davis Hwy, Suite 1004
Arlington, VA 22202-4102
www.cganet.com
(703) 412-0900

**CISCA**
Ceilings and Interior Systems Construction Association
1500 Lincoln Hwy, Suite 202
St. Charles, IL 60174
www.cisca.org
(630) 584-1919

**CISPI**
Cast Iron Soil Pipe Institute
5959 Shallowford Rd., Suite 419
Chattanooga, TN 37421
www.cispi.org
(423) 892-0137

**CLFMI**
Chain Link Fence Manufacturers Institute
9891 Broken Land Pkwy, Suite 300
Columbia, MD 21046
www.chainlinkinfo.org
(301) 596-2583

**CRI**
Carpet and Rug Institute
310 S. Holiday Ave.
Dalton, GA 30722-2048
www.carpet-rug.com
(800) 882-8846
(706) 278-3176

**CRSI**
Concrete Reinforcing Steel Institute
933 N. Plum Grove Rd.
Schaumburg, IL 60173-4758
www.crsi.org
(847) 517-1200

**CSSB**
Cedar Shake and Shingle Bureau
P.O. Box 1178
Sumas, WA 98295
www.cedarbureau.org
(604) 462-8961

**CSI**
Construction Specifications Institute
99 Canal Center Plaza, Suite 300
Alexandria, VA 22314
www.csinet.org
(800) 689-2900

**CTI**
Cooling Technology Institute
530 Wells Fargo Drive, Suite 218
Houston, TX 77090
www.cti.org
(281) 583-4087

**DASMA**
Door and Access Systems Manufacturers Association International
1300 Summer Avenue
Cleveland, OH 44115-2851
www.dasma.com
(216) 241-7333

**DHI**
The Door and Hardware Institute
14150 Newbrook Dr., Suite 200
Chantilly, VA 20151
www.dhi.org
(703) 222-2010

**DIPRA**
Ductile Iron Pipe Research Association
245 Riverchase Parkway East, Suite O
Birmingham, AL 35244
www.dipra.org
(205) 402-8700

**EIMA**
EIFS Industry Members Association
3000 Corporate Center Dr., Suite 270
Morrow, GA 30260
www.eifsfacts.com
(800) 294-3462
(770) 968-7945

**EPA**
Environmental Protection Agency
US EPA/NSCEP
P.O. Box 42419
Cincinatti, Ohio 45242
www.epa.gov
(800) 490-9198

**EPRI**
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94304
WWW.EPRI.COM
(650) 855-8900

**FAA**
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591
www.faa.gov
(202) 366-4000

**FIBA**
International Basketball Federation
(Federation Internationale De Basketball)
8, Ch. De Blandonnet
1214 Vernier / Geneva
Switzerland
www.fiba.com
(+41-22) 545.00.00

**FM**
FM Global
Corporate Headquarters.
P.O. Box 7500
Johnston, RI 02919
www.fmglobal.com
(401) 275-3000

**FS**
Federal Specification Unit
General Services Admin.
Federal Supply Service
FSS Acquisition Management Center
Environmental Programs and Engineering Policy Division
Washington, DC 20406
www.gsa.gov
(703) 305-5682

**FSC**
Forest Stewardship Council
1155 30th St. NW
Suite 300
Washington, DC 20007
www.fscus.org
(877) 372-5646

**GA**
Gypsum Association
810 First St., NE, Suite 510
Washington, DC 20002
www.usg.com
www.gypsum.org
(202) 289-5440

**GANA**
Glass Association of North America
2945 Southwest Wanamaker Dr., Suite A
Topeka, KS 66614
www.glasswebsite.com
(785) 271-0208

**GS**
Green Seal
1001 Connecticut Ave.
Suite 827
Washington, DC 20036-5525
www.greenseal.org
(202) 872-6400

**HI**
Hydronics Institute
Division of Gas Appliance Manufacturers Association
2107 Wilson Blvd., Suite 600
Arlington, VA 22201
www.gamanet.org
(703) 525-7060

**HMMA**
Hollow Metal Manufacturers Association
Division of NAAMM
8 South Michigan Ave., Suite 1000
Chicago, IL 60603
www.naamm.org
(312) 332-0405

**HPVA**
Hardwood Plywood and Veneer Association
P.O. Box 2789
Reston, VA 20195-0789
www.hpva.org
(703) 435-2900

**IAS**
International Approval Services
U.S. Operations
8501 E. Pleasant Valley Rd.
Cleveland, Ohio 44131-5575
www.iasonline.org
(216) 524-4990

**ICC**
International Code Council
5203 Leesburg Pike #708
Falls Church, VA 22041
www.iccsafe.org
(703) 931-4533

**IEEE**
Institute of Electrical and Electronics Engineers
3 Park Ave., 17th Floor
New York, NY 10016-5997
www.ieee.org
(212) 419-7900

**IES**
Illuminating Engineering Society of North America
120 Wall Street, 17th Floor
New York, NY 10005
www.iesna.org
(212) 248-5000

**IGSHPA**
International Ground Source Heat Pump Association
Oklahoma State University
499 Cordell South
Stillwater, OK 74078
www.igshpa.okstate.edu
(800) 626-4747

**ILI**
Indiana Limestone Institute of America
400 Stone City Bank Building
Bedford, IN 47421
www.iliai.com
(812) 275-4426

**ISO**
International Organization for Standardization
1, rue de Varembé, Case postale 56
CH-1211 Geneva 20, Switzerland
www.iso.org
+41 22 749 01 11

**KCMA**
Kitchen Cabinet Manufacturers Association
1899 Preston White Dr.
Reston, VA 20191-5435
www.kcma.org
(703) 264-1690

**LPI**
Lightning Protection Institute
3335 N. Arlington Heights Rd., Suite E
Arlington Heights, IL 60004
www.lightning.org
(800) 488-6864
(847) 577-7200

**MBMA**
Metal Building Manufacturers Association
1300 Sumner Ave.
Cleveland, OH 44115-2851
www.mbma.com
(216) 241-7333

**MFMA**
Maple Flooring Manufacturers Association
60 Revere Dr., Suite 500
Northbrook, IL 60062
www.maplefloor.org
(847) 480-9138

**MIA**
Marble Institute of America
30 Eden Alley, Suite 301
Columbus, OH 43215
www.marble-institute.com
(614) 228-6194

**MIL**
Military Standardization Documents
Defense Automated Printing Service
700 Robbins Ave., Building 4D
Philadelphia, PA 19111-5094
www.dodssp.daps.mil
(215) 697-2179

**MSS**
Manufacturers Standardization Society of the Valve and Fittings Industry
127 Park St., NE
Vienna, VA 22180-4602
www.mss-hq.com
(703) 281-6613

**NAA**
National Arborist Association
Route 101, P.O. Box 1094
Amherst, NH 03031-1094
www.natlarb.com
(800) 733-2622
(603) 673-3311

**NAAMM**
National Association of Architectural Metal Manufacturers
800 Roosevelt Road, Building C, Suite 312
Glen Ellyn, IL 60137
www.naamm.org
(630) 942-6591

**NAAMM**
North American Association of Mirror Manufacturers
(Division of GANA)
2945 Southwest Wanamaker Dr., Suite A
Topeka, KS 66614
www.glasswebsite.com
(913) 266-7013

**NACE**
NACE International
1440 South Creek Drive
Houston, TX 77084
www.nace.org
(281) 228-6200

**NAIMA**
North American Insulation Manufacturers Association
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314
www.naima.org
(703) 684-0084

**NBGQA**
National Building Granite Quarries Association, Inc.
1220 L. St., NW, Suite 100-167
Washington, DC 20005
www.nbgqa.com
(800) 557-2848

**NCAA**
The National Collegiate Athletic Association
700 W. Washington Street
P.O. Box 6222
Indianapolis, Indiana 46206-6222
www.ncaa.org
(317) 917-6222

**NCMA**
National Concrete Masonry Association
2302 Horse Pen Rd.
Herndon, VA 20171-3499
www.ncma.org
(703) 713-1900

**NCRP**
National Council on Radiation Protection and Measurement
7910 Woodmont Ave., Suite 800
Bethesda, MD 20814-3095
www.ncrponline.com
(301) 657-2652

**NEBB**
National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877
www.nebb.org
(301) 977-3698

**NECA**
National Electrical Contractors Association
3 Bethesda Metro Center, Suite 1100
Bethesda, MD 20814
www.necanet.org
(301) 657-3110

**NELMA**
Northeastern Lumber Manufacturers Association
272 Tuttle Rd.
P.O. Box 87A
Cumberland Center, ME 04021
www.nelma.org
(207) 829-6901

**NEMA**
National Electrical Manufacturers Association
1300 N 17th St., Suite 1847
Rosslyn, VA 22209
www.nema.org
(703) 841-3200

**NETA**
International Electrical Testing Association
P.O. Box 687
106 Stone St.
Morrison, CO 80465
www.netaworld.org
(303) 697-8441

**NFHS**
National Federation of State High School Associations
P.O. Box 690
Indianapolis, Indiana 46206
www.nfhs.org
(317) 972-6900

**NFPA**
National Fire Protection Association
One Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9101
www.nfpa.org
(800) 344-3555
(617) 770-3000

**NFRC**
National Fenestration Rating Council
1300 Spring St., Suite 500
Silver Spring, MD 20910
www.nfrc.org
(301) 589-6372

**NIBS**
National Institute of Building Sciences
1090 Vermont Ave., NW, Suite 700
Washington, DC 20005-4905
www.nibs.org
(202) 289-7800

**NIST**
National Institute of Standards and Technology
100 Bureau Dr., MS 2150
Gaithersburg, MD 20899-2150
www.nist.gov
(301) 975-4025

**NLA**
National Lime Association
200 North Glebe Rd., Suite 800
Arlington, VA 22203
www.lime.org
(703) 243-5463

**NLGA**
National Lumber Grades Authority
#406-First Capital Pl.
960 Quayside Dr.
New Westminster, BC V3M 6G2
CANADA
www.nlga.org
(604) 524-2393

**NOFMA**
National Oak Flooring Manufacturers Association
P.O. Box 3009
Memphis, TN 38173-0009
www.nofma.org
(901) 526-5016

**NOMMA**
National Ornamental and Miscellaneous Metals
532 Forest Pkwy., Suite A
Forest Park, GA 30297
www.nomma.org
(404) 363-4009

**NPCA**
National Paint and Coatings Association
1500 Rhode Island Ave., NW
Washington, DC 20005
www.paint.org
(202) 462-6272

**NPCA**
National Precast Concrete Association
10333 N Meridian St. Ste. 272
Indianapolis IN 46290-1081
www.precast.org
(317) 571-9500

**NRCA**
National Roofing Contractors Association
O'Hare International Center
10255 W. Higgins Rd., Suite 600
Rosemont, IL 60018
www.roofonline.org
(847) 299-9070

**NSF**
NSF International
P.O. Box 130140
Ann Arbor, MI 48113-0140
www.nsf.org
(734) 769-8010
(800) 673-6275

**NSPI**
National Spa and Pool Institute
2111 Eisenhower Ave.
Alexandria, VA 22314
www.nespapool.org
(703) 838-0083

**NTMA**
National Terrazzo and Mosaic Association
110 E. Market St., Suite 200-A
Leesburg, VA 20176
www.ntma.com
(800) 323-9736
(703) 779-1022

**NUCA**
National Utility Contractors Association
4301 North Fairfax Dr., Suite 360
Arlington, VA 22203-1627
www.nuca.com
(703) 358-9300

**PCA**
Portland Cement Association
5420 Old Orchard Rd.
Skokie, IL 60077
www.cement.org
(847) 966-6200

**PCI**
Precast/Prestressed Concrete Institute
209 W. Jackson Blvd.
Chicago, IL 60606-6938
www.pci.org
(312) 786-0300

**PDCA**
Painting and Decorating Contractors of America
3913 Old Lee Hwy, Suite 33-B
Fairfax, VA 22030
www.pdca.com
(703) 359-0826

**PDI**
Plumbing and Drainage Institute
45 Bristol Dr.
South Easton, MA 02375
www.PDIonline.org
(800) 589-8956

**PEI**
Petroleum Equipment Institute
P.O. Box 2380
Tulsa, OK 74101-2380
www.pei.org
(918) 494-9696

**PTI**
Post Tensioning Institute
1717 W. Northern Ave., Suite 114
Phoenix, AZ 85021
www.post-tensioning.org
(602) 870-7540

**RCSC**
Research Council on Structural Connections
www.boltcouncil.org

**RIS**
The Redwood Inspection Service
630 J Street
Eureka, CA 95501
(707) 444-3024

**SCAQMD**
South Coast Air Quality Management District
21865 E. Copley Dr.
Diamond Bar, CA 91765
www.cypressinfo.org
(800) 288-7664
(909) 396-2000

**SCMA**
Southern Cypress Manufacturers Association
400 Penn Center Blvd., #530
Pittsburgh, PA 15235
www.cypressinfo.org
(877) 607-7262

**SDI**
Steel Deck Institute
P.O. Box 25
Fox River Grove, IL 60021
www.sdi.org
(847) 462-1930

**SDI**
Steel Door Institute
30200 Detroit Rd.
Cleveland, OH 44145-1967
www.steeldoor.org
(440) 899-0010

**SIGMA**
Sealed Insulating Glass Manufacturers Association
401 N. Michigan Ave.
Chicago, IL 60611
www.igmaonline.org
(312) 644-6610

**SJI**
Steel Joist Institute
3127 10th Ave., North Ext.
Myrtle Beach, SC 29577-6760
(843) 626-1995

**SMACNA**
Sheet Metal and Air Conditioning Contractors'
National Association
4201 Lafayette Center Dr.
Chantilly, VA 20151-1209
www.smacna.org
(703) 803-2980

**SPIB**
Southern Pine Inspection Bureau
4709 Scenic Hwy
Pensacola, FL 32504-9094
www.spib.org
(850) 434-2611

**SPRI**
Single Ply Roofing Institute
200 Reservoir St., 309 A
Needham, MA 02494
www.spri.org
(781) 444-0242

**SSPC**
SSPC: The Society for Protective Coatings
40 24th St., 6th Floor
Pittsburgh, PA 15222-4656
www.sspc.org
(800) 837-8303
(412) 281-2331

**STI**
Steel Tank Institute
570 Oakwood Rd.
Lake Zurich, IL 60047
www.steeltank.com
(847) 438-8265

**SWI**
Steel Window Institute
1300 Sumner Ave.
Cleveland, OH 44115-2851
www.steelwindows.com
(216) 241-7333

**SWRI**
Sealant, Waterproofing and Restoration Institute
2841 Main St.
Kansas City, MO 64108
www.swrionline.org
(816) 472-7974

**TCA**
Tile Council of America, Inc.
100 Clemson Research Blvd.
Anderson, S.C. 29625
www.tileusa.com
(864) 646-8453

**TIA/EIA**
Telecommunications Industry Association
/Electronic Industries Alliance
2500 Wilson Blvd., Suite 300
Arlington, VA 22201
www.tiaonline.org
(703) 907-7700

**TMS**
The Masonry Society
3970 Broadway, Suite 201-D
Boulder, CO 80304-1135
www.masonrysociety.org
(303) 939-9700

**TPI**
Truss Plate Institute
583 D'Onofrio Dr., Suite 200
Madison, WI 53719
www.tpinst.org
(608) 833-5900

**TPI**
Turfgrass Producers International
1855-A Hicks Rd.
Rolling Meadows, IL 60008
www.turfgrassod.org
(800) 405-8873
(847) 705-9898

**UL**
Underwriters Laboratories Inc.
333 Pfingsten Rd.
Northbrook, IL 60062-2096
www.ul.com
(847) 272-8800

**USGBC**
U.S. Green Building Council
1015 18th St., NW, Suite 805
Washington, DC 20036
www.usgbc.org
(202) 828-7422

**WCLIB**
West Coast Lumber Inspection Bureau
P.O. Box 23145
Portland, OR 97281
www.wclib.org
(503) 639-0651

**WDMA**
Window and Door Manufacturers Association
1400 E. Touhy Ave., Suite 470
Des Plaines, IL 60018
(800) 223-2301

**WH**
Intertek Testing Services
(Warnock Hersey Listed)
3210 American Drive
Mississauga, Ontario
Canada L4V 1B3
www.intertek-etlsemko.com
(905) 678-7820

**WI**
Woodwork Institute
3188 Industrial Blvd.
West Sacramento, CA 95691
www.woodworkinstitute.com
(916) 372-9943

**WWPA**
Western Wood Products Association
522 SW 5th Ave., Suite 500
Portland, OR 97204-2122
www.wwpa.org
(503) 224-3930

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Telephone, facsimile, and internet service.
   3. Temporary water service.
   4. Temporary sanitary facilities.

B. Construction Facilities:
   1. Contractor's Field offices.
   2. Engineer's Field Office.

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

D. Removal of temporary utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Contractor may utilize permanent convenience outlets for normal work with small tools and 120-volt power supply. Any connections to electrical or equipment control panels must be preapproved by the Owner.

B. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.

C. For other power requirements, the Contractor shall utilize temporary power generators or make provisions with power company for separate electrical service.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations.

B. Maintain lighting and provide routine repairs.

1.4 TELEPHONE, FACSIMILE AND INTERNET SERVICE

A. Contactor shall be responsible for all site telephone requirements utilizing cellular phones. No telephone, internet or facsimile services will be provided.

## 1.5 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required temporary facilities and enclosures. Existing facility use is not permitted other than a temporary office and restroom facility located within the Maintenance Building. Provide facilities at time of project mobilization.

B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

## 1.6 CONTRACTORS FIELD OFFICES AND SHEDS

A. Provide weather tight office with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 8 persons.

C. Provide separate private office, similarly equipped and furnished, for use of Engineer and Owner.

D. Do not use permanent facilities for field offices or for storage without written permission from Owner.

E. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
   1. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces. Maintain during progress of Work; remove when no longer needed.
   2. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
   3. Exterior Materials: Weather resistant, finished in color acceptable to Engineer.
   4. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
   5. Lighting for Offices: 50 ft-C at desk top height, exterior lighting at entrance doors.
   6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

F. Environmental Control:
   1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
   2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.

G. Storage Areas And Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 00 21 13[14] – Instructions to Bidders.

H. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.

I. Installation: Install office spaces ready for construction purposes.

J. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

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

L. Location as indicated on Drawings or approved by Engineer.

M. Provide unimpeded access for emergency vehicles. Maintain 20-foot wide driveways with turning space between and around combustible materials.

N. Provide and maintain access to fire hydrants and control valves free of obstructions.

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

## 1.7 ENGINEERS FIELD OFFICE

A. Separate space for sole use of Owner and Engineer, with separate entrance door with new lock and two keys.

B. Area: Minimum 150 square feet, minimum dimension 8 feet.

C. Windows: Minimum three windows with minimum total area of 10 percent of floor area, with operable sash and insect screens. Locate to provide views of construction area.

D. Electrical Distribution Panel: Two circuits minimum, 110 volt, 60 Hz service.

E. Minimum four 110 volt duplex convenience outlets, one on each wall.

F. Telephone: Maintain one line for voice and dedicated facsimile line.

G. Sanitary Facilities: Convenient access to private lavatory toilet facilities.

H. Drinking Fountain: Convenient access by workers.

I. Office Furnishings:
   1. One desk 54 x 30 inches with three drawers.
   2. One drafting table 36 x 72 inches with one equipment drawer and full width parallel straight edge.
   3. One metal, double-door storage cabinet under table.
   4. Plan rack to hold working Drawings, shop drawings, and record documents.

5. One standard four-drawer legal - size metal filling cabinet with locks and two keys for each lock.
6. Six linear feet of metal bookshelves.
7. Two swivel arm chairs.
8. Two straight chairs.
9. One drafting table stool.
10. One tack board 36 x 30 inch.
11. One waste basket for each desk and table.

1.8 PROJECT IDENTIFICATION - N/A

1.9 VEHICULAR ACCESS

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

B. Location as indicated on Drawings or approved by Engineer.

C. Provide unimpeded access for emergency vehicles. Maintain 20-foot wide driveways with turning space between and around combustible materials.

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

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

F. Contractor shall be responsible for all damage to existing pavement associated with the work and final overlay of designated existing asphalt pavement upon completion of project.

G. Contractor shall be responsible for site cleanup and disposal associated with vehicles leaking oil or hydraulic products on site in compliance with site stormwater permit.

1.10 PARKING

A. Provide temporary gravel surface parking areas to accommodate construction personnel.

B. Locate as indicated on Drawings or as approved by Engineer.

C. When site space is not adequate, provide additional off-site parking.

D. Use of designated existing on-site streets and driveways for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.

E. Use of designated areas of existing parking facilities by construction personnel is not permitted.

F. Do not allow heavy vehicles or construction equipment in parking areas.

G. Permanent Pavements And Parking Facilities:
1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.

2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
3. Use of permanent parking structures is not permitted.

H. Maintenance:
1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

I. Removal, Repair:
1. Remove temporary materials and construction at Substantial Completion.
2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
3. Repair existing or permanent facilities damaged by use, to original or specified condition.

J. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

## 1.11 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

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

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

## 1.12 FIRE PREVENTION FACILITIES

A. Prohibit smoking with buildings under construction and demolition. Designate area on site where smoking is permitted. Provide approved ashtrays in designated smoking areas.

B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

C. Standpipes: Maintain existing standpipes in usable condition to height within one floor of floor being demolished.

D. Portable Fire Extinguishers: NFPA 10; 10 pound capacity, 4A-60BC UL rating.
   1. Provide one fire extinguisher at each stair on each floor of buildings under construction and demolition.
   2. Provide minimum one fire extinguisher in every construction trailer and storage shed.
   3. Provide minimum one fire extinguisher on roof during roofing operations using heat producing equipment.

1.13 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.14 ENCLOSURES AND FENCING

A. Construction: Plastic construction netting.

1.15 SECURITY

A. Security Program:
   1. Protect Work and existing premises from theft, vandalism, and unauthorized entry.
   2. Initiate program at project mobilization.
   3. Maintain program throughout construction period until Owner acceptance precludes need for Contractor security.

1.16 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.17 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.18 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes, and drains, and other devices as indicated to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.19 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction including but not limited to the North Carolina Department of Environment and Natural Resources (NCDENR) Stormwater Permit.

1.20 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.

B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

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SECTION 01 60 80
WATER TIGHTNESS TEST FOR HYDRAULIC STRUCTURES

## PART 1 GENERAL

### 1.1 SCOPE OF WORK

A. Furnish all labor, materials and incidentals required and perform watertightness testing of water-containing structures as listed herein and all retesting until the structures meet the requirements as specified herein.

### 1.2 RELATED SECTIONS

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

### 1.3 SUBMITTALS

A. Submit, in accordance with Section 01 33 01 - Submittal Procedures EPMS, the results of each watertightness test of each structure. The submittal format shall be similar to that shown in Figure A attached to end of this Section.

### 1.4 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

B. American Concrete Institute (ACI)
   1. ACI 350.1 - Tightness Testing of Environmental Engineering Concrete Structures.

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

### 1.5 PROJECT/SITE REQUIREMENTS

A. Coordinate timing and procedures for obtaining testing water and structure testing with the Engineer and Owner two weeks in advance of the actual testing.

B. Test shall be performed when no precipitation or freezing weather conditions are forecast.

C. Water Source and Disposal
   1. Contractor can use non-potable water from the existing plant UV system effluent or purchased potable water available from a fire hydrant. Obtain Owner's approval for obtaining water for testing. All temporary pumps and piping for filling the tank shall be provided by the Contractor at no expense to the Owner.
   2. Test water shall be disposed of by reintroduction into the existing Plant treatment process using the RAS pumps or plant drains into the plant sewer or Contractor provided temporary pumps and piping at a time, rate of flow and location approved by the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. The testing of concrete water containment structures shall conform to the following standards and as modified herein:
   1. Reinforced concrete liquid-containing structures - ACI 350.1 and as specified herein.

B. Perform watertightness test prior to placing backfill around structure in order to permit observation and detection of leakage points. Walls may be backfilled prior to testing only when approved in writing by the Engineer. The request to backfill prior to testing shall include a description of the method proposed to detect leakage points after the backfill is in place. Approval to place backfill prior to testing shall not relieve the Contractor of the responsibility for conducting watertightness tests.

3.2 PREPARATION

A. Thoroughly clean the structure to be tested of dirt, mud and construction debris prior to initiating watertightness tests. The floor and sumps shall be flushed with water to provide a clean surface, ready for testing.

B. Inspect the structure to be tested for potential leakage paths such as cracks, voids, etc and repair such paths in compliance with the provisions specified herein or as approved by the Engineer.

C. Confirm adequacy of seals around gates and valves and reset or seal as approved by the Engineer. Estimates of gate or valve leakage will not be allowed as adjustments to the measured tank or structure leakage.

D. Inlet and outlet pipes not required to be operational for the tests may be temporarily sealed or bullheaded prior to testing.

3.3 TESTING PROCEDURES

A. Conditions of Testing
   1. Perform tightness testing in conformance with Chapter 2 of ACI 350.1 (hydrostatic test).
   2. Do not begin initial filling of concrete structures until all concrete elements of the structure have attained the design 28-day compressive strength of the concrete, nor less than 14 days after all concrete walls or base slabs have been placed.
   3. Initial filling rate, water depth and waiting period shall conform to the requirements of ACI 350.1.
   4. Fill unlined or partially lined concrete structures to the maximum operating water surface level and maintain the water at that level for at least 72 hours prior to beginning watertightness tests to minimize water adsorption by the concrete during testing.

B. Testing Procedures

1. Duration of the test shall not be less than that required for a drop in the water surface of 3/8-in based on the calculated maximum allowable leakage rate but need not exceed 5 days.
2. Loss of volume measurements shall be taken at 24-hour intervals. The loss of volume is usually determined by measuring the drop-in water surface elevation and computing the change in volume of the contained water. Measure water surface elevation at not less than two locations at 180 degrees apart and preferably at four locations 90 degrees apart. Record water temperature 18-in below the water surface when taking the first and last sets of measurements.

C. Reports
1. Submit to the Engineer watertightness test results for each structure.
2. Notify the Engineer of the scheduling of tests 5 working days prior to the tests. The Engineer will monitor any watertightness testing performed on the structures.

## 3.4 ACCEPTANCE

A. The following conditions shall be considered as NOT meeting the criteria for acceptance regardless of the actual loss of water volume from the structure.
1. Ground water leakage into the structure.
2. Structures which exhibit water flowing from the tank or from beneath the foundation (except for underdrain systems).
3. Other requirements of ACI 350.1.

## 3.5 REPAIRS AND RETESTING

A. Structures failing the watertightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Tanks failing this retest shall be repaired prior to further testing. All repair methods shall be acceptable to the engineer.

B. Repair structures which fail the watertightness test and structures showing visible leakage in compliance with the provisions specified herein or as approved by the Engineer.

C. Repairs and retesting of tanks shall be accomplished at no additional cost to the Owner.

## 3.6 SCHEDULE

1. The following structures shall be tested for watertightness:
2. Influent Screening and Vortex Grit Separator
3. SBR Flow Splitter Basin
4. SBR #3 and #4
5. Digesters #3 & 4
6. Sludge Holding Tank #2

FIGURE A
WATERTIGHTNESS TEST REPORT

PROJECT _____
SUBMITTED BY_____
STRUCTURE* _____
TEST DATES_____
Allowable loss of water volume _____percent in 24 hrs.
Measured loss of water volume _____percent in 24 hrs.

TEST READINGS
Water temperature at start _____degrees F Water temperature at end _____degrees F

| | Date | Time | Location 1 | Location 2 | Location 3 | Location 4 | Initials |
|---|---|---|---|---|---|---|---|
| 1. | | | | | | | |
| 2. | | | | | | | |
| 3. | | | | | | | |
| 4. | | | | | | | |
| 5. | | | | | | | |

Change in level _____
Average change in level _____
Correction for precipitation/evaporation_____
Corrected change in level = CL = _____
(CL) x (surface area) x (100) = measured percent water loss in 24 hrs.
(initial water volume) x (number of test days)

Notes and field observations**

* Attach a sketch showing a plan of the structure and measurement locations.
** Place date and initials at the beginning of each entry.

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Starting of systems.

D. Demonstration and instructions.

E. Protecting installed construction.

F. Project record documents.

G. Operation and maintenance data.

H. Manual for materials and finishes.

I. Manual for equipment and systems.

J. Spare parts and maintenance products.

K. Product warranties and product bonds.

L. Testing, adjusting and balancing.

### 1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.

B. Provide submittals to Engineer required by authorities having jurisdiction.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

D. Owner will occupy portions of building as specified in Section 01 10 00 - Summary.

### 1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

D. Replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean site; sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from site.

H. Restoration of all disturbed site areas to existing condition or better to include removal of all debris, fine grading, seeding and removal of silt fence and temporary erosion control upon establishment of vegetation and within 30 days of project substantial completion.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer and Owner seven days prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01 33 01 - Submittal Procedures EPMS that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of substantial completion. All training services shall be provided after completion of checkout and startup with equipment fully operational. Training shall be scheduled with Owner and record maintained of personnel attending training session with

a minimum period of four (4) hour provided for operator operation and maintenance training.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at equipment location.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

F. Required instruction time for each item of equipment and system is specified in individual Sections.

## 1.6 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

## 1.7 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

G. Submit documents to Engineer.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring capacity expansion binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions arranged by system or process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.

f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Air and water balance reports.
   c. Certificates.
   d. Originals and Photocopies of warranties and bonds.

1.9 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for reordering custom manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.

H. Additional Requirements: As specified in individual product Specification Sections.

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed or by label machine.

G. Include color coded wiring diagrams as installed.

H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

J. Include servicing and lubrication schedule, and list of lubricants required.

K. Include manufacturer's printed operation and maintenance instructions.

L. Include sequence of operation by controls manufacturer.

M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

N. Include control diagrams by controls manufacturer as installed.

O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.

P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

R. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.

S. Additional Requirements: As specified in individual product Specification Sections.

T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

B. Deliver to project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.12 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond date of substantial completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.13 TESTING, ADJUSTING AND BALANCING

A. Contractor will employ services of independent firm Owner approved to perform testing, adjusting, and balancing. Contractor shall pay for services as specified in Section 01 20 00 - Price and Payment Procedures.

B. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE ACI

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Formwork and accessories.
2. Shoring, bracing, and anchorage.
3. Reinforcing bars.
4. Welded wire fabric.
5. Inserts and accessories.
6. Cast-in-place concrete.

B. Related Sections:
1. Section 01 60 80 - Watertightness Test for Hydraulic Structures
2. Section 31 23 16 - Excavation and Fill NC: Excavation for Work of this Section.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306.1 - Standard Specification for Cold Weather Concreting.
5. ACI 308.1 - Standard Specification for Curing Concrete.
6. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures.
7. ACI 350.1 - Tightness Testing of Environmental Engineering Concrete Structures.
8. ACI 530.1 - Specifications for Masonry Structures.
9. ACI SP-66 - ACI Detailing Manual.

B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. ASTM International:
1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.
9. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
10. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
14. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
15. ASTM C685 - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
16. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
17. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
18. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
19. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
20. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
21. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
22. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

E. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

F. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

G. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard No. 17 Grading Rules for West Coast Lumber.

## 1.3 PERFORMANCE REQUIREMENTS

A. Vapor Retarder Permeance: Maximum 0.3 perm when tested in accordance with ASTM E96, Procedure A.

1.4 SUBMITTALS

A. Section 01 22 01 - Electronic Project Management System and Section 01 33 01 - Submittal Procedures EPMS: Submittal procedures.

B. Product Data: Submit data on joint devices, attachment accessories, and admixtures.

C. Shop Drawings:
   1. Steel Reinforcement: Placing drawings that detail fabrication, bending, and placement in accordance with CRSI Manual of Standard Practice and ACI 315, Details and Detailing of Concrete Reinforcement, unless otherwise specified on the Drawings. Include bar sizes, lengths, material, grade, bar schedules, bar clearances, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   2. Formwork: Prepared by or under the supervision of a qualified professional engineer registered in the state of the project. Detailing, fabrication, assembly, support of formwork, shoring and bracing to conform to design and code requirements, and resultant concrete to conform to required shape, line, and dimension.

D. Certificates: Submit AWS qualification certificate for welders employed on the Work.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
   1. Submit certified copies of mill test report of reinforcement materials analysis.

F. Concrete Design Data: Submit mix designs for each class of concrete required. Indicate whether mixes have been designed for pumping. Submittal for each mix design shall be complete and include the following:
   1. A mix design summary sheet indicating types and quantities of all cements, aggregates, water, admixtures, and all other mix constituents and resulting slumps, water/cement ratios, and entrained air percentages.
   2. Test data for each aggregate used to include, as a minimum, plant location, sieve analysis, specific gravity, absorption, and soundness.
   3. Compression test results of each proposed mix to include the following:
      a. Results from not less than 30 consecutive compressive strength tests, performed within the preceding 90 days on concrete provided from the same plant and of the same materials and essentially same mix. A compressive strength test shall be defined as the average 28-day compressive strength of companion cylinders made conforming to ASTM C172 and ASTM C31 and tested in conformation with ASTM C39.
      b. Computation of the average strength and standard deviation of the compressive strength data, as established by ACI 350.
      c. Demonstration that the average strength of the proposed mix design meets or exceeds the specified strength in accordance with Chapter 5 of ACI 350.

G. Certificates: Letters of certification shall be submitted from the manufacturers of each admixture and the supplier of each type of aggregate and concrete certifying that the materials proposed meet the ASTM requirements specified elsewhere in this Section. In addition, should

admixtures from varying manufacturers be utilized, concrete supplier shall certify, in writing, that all products are compatible for use in the design mix.

H. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

I. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's Plant and Truck Certification Program, Certification of Production Facilities.

B. Testing Agency Qualifications: An independent agency acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1(08), or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade 1. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site.
   1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.

d. Concrete subcontractor.
e. Special Inspector if Special Inspections are required by the Statement of Special Inspections.

H. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor Perform Work in accordance with ACI 301.

I. For wood products furnished for work of this Section, comply with AF&PA.

J. Prepare shop drawings in accordance with ACI SP-66.

K. Conform to ACI 305 when concreting during hot weather.

L. Conform to ACI 306.1 when concreting during cold weather.

M. Acquire cement and aggregate from one source for Work.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

B. Maintain high early strength concrete temperature after installation at minimum 50 degrees F for minimum 3 days.

1.7 COORDINATION

A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver void forms and installation instructions in manufacturer's packaging. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood Forms:
1. Application: Use for exposed finish concrete.
2. Forms: Conform to PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8-inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.

4. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4-inch thick.

## 2.2 PREFABRICATED FORMS

A. Manufacturers:
   1. Aluma-Systems Inc., Burke Co.
   2. Economy Forms Corp.
   3. Molded Fiber Glass Concrete Forms Co.
   4. Perma Tubes.
   5. Sonoco Products Co.
   6. Symons Corp. Product Western Forms, Inc.
   7. Product Substitutions: Equal per EJCDC® C-200 - Instructions to Bidders.

## 2.3 FORMWORK ACCESSORIES

A. Form Ties: Removable type, adjustable length, with waterproofing washer, free of defects capable of leaving holes larger than 1 inch in concrete surface, and leaving no metal within 1 inch of exposed surface.

B. Spreaders: Standard non-corrosive metal form clamp assembly of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders, or through bolts are not permitted.

C. Form Anchors and Hangers:
   1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
   2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
   3. Penetration of structural steel members is not permitted.

D. Form Release Agent: Colorless mineral oil that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
   1. Manufacturers:
      a. Arcal Chemical Corporation, Arcal-80.
      b. Industrial Synthetics Company, Synthex.
      c. Nox-Crete Company, Nox-Crete Form Coating.
      d. Substitutions: EJCDC® C-200 - Instructions to Bidders.

E. Corners exposed to view: Fillet and Chamfer; rigid plastic or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.

F. Vapor Retarder: Where indicated on Drawings, 6 mil thick polyethylene sheet.

G. Bituminous Joint Filler: ASTM D1751.

H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

## 2.4 REINFORCEMENT

A. Deformed Reinforcement: ASTM A615; 60 ksi yield strength, steel bars, unfinished or epoxy coated finish as indicated on Drawings.

B. Welded Deformed Steel Bar Mats: ASTM A184; fabricated from ASTM A615 60 ksi yield strength, steel bars, unfinished or epoxy coated finish as indicted on Drawings.

## 2.5 REINFORCEMENT ACCESSORIES

A. Tie Wire: Minimum 16 gage annealed type, epoxy coated.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel type; size and shape to meet Project conditions.

D. Reinforcing Splicing Devices: Exothermic welding type or mechanical threaded type; full tension and compression; sized to fit joined reinforcing.

E. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

## 2.6 REINFORCEMENT FABRICATION

A. Fabricate concrete reinforcement in accordance with ACI 350.

B. Form standard hooks for 180 degree bends, 90 degree bend, stirrup and tie hooks; and seismic hooks as indicated on Drawings.

C. Form reinforcement bends with minimum diameters in accordance with ACI 350.

D. Fabricate column reinforcement with offset bends at reinforcement splices.

E. Form spiral column reinforcement from minimum 3/8-inch diameter continuous deformed bar or wire.

F. Form ties and stirrups from the following:
   1. For bars No. 10 and Smaller: No. 3 deformed bars.
   2. For bars No. 11 and Larger: No. 4 deformed bars.

G. Weld reinforcement in accordance with AWS D1.4.

H. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with Engineer.

## 2.7 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents. Specified shop tests are not required for Work performed by approved fabricator.

## 2.8 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I or II

B. Normal Weight Aggregates: ASTM C33.
   1. Coarse Aggregate Maximum Size: In accordance with ACI 350.

C. Water: ACI 350; potable, without deleterious amounts of chloride ions.

## 2.9 CONCRETE ADMIXTURES

A. Manufacturers:
   1. Degussa Admixtures, Inc. (Master Builders).
   2. Euclid Chemical Co.
   3. Fritzpak Concrete Admixtures Co.
   4. Grace Construction Products.
   5. Larsen Products Corp.
   6. L & M Construction Chemicals.
   7. Sika Chemical Co.
   8. W. R. Meadows Inc.
   9. Substitutions: . EJCDC® C-200 - Instructions to Bidders.

B. Air Entrainment: ASTM C260.

C. Chemical: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride. ASTM C494:
   1. Type A - Water Reducing.
   2. Type B - Retarding.
   3. Type C - Accelerating.
   4. Type D - Water Reducing and Retarding.
   5. Type E - Water Reducing and Accelerating.
   6. Type F - Water Reducing, High Range.
   7. Type G - Water Reducing, High Range and Retarding.

D. Fly Ash: ASTM C618, Class F.

E. Plasticizing: ASTM C1017, Type I - Plasticizing or Type II - Plasticizing and retarding.

## 2.10 CONCRETE ACCESSORIES

A. Bonding Agent:
   1. Not exposed to water after placement: Polyvinyl Acetate.
   2. Exposed to water after placement: Latex emulsion or epoxy adhesive.

B. Vapor Retarder: ASTM E1745 Class A; 10 mil thick polyethylene film; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

C. Non-Shrink Grout: ASTM C1107, Grade A or B; premixed compound consisting of non metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 3 days and 7,000 psi in 28 days.

## 2.11 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler: ASTM D1751 or ASTM D994; Preformed asphalt impregnated fiberboard or felt, thickness as indicated on Drawings; tongue and groove profile.

B. Sealant: ASTM D6690, Type III.

C. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes leaving only butt joint splices for the field.
   1. Manufacturers:
      a. Bometals, Inc.
      b. Greenstreak.
      c. Meadows, W. R., Inc.
      d. Progress Unlimited, Inc.
      e. Tamms Industries, Inc.
      f. Vinylex Corp.
   2. Profile: Center bulb.

## 2.12 CONCRETE MIX

A. Provide concrete as noted on drawings.

B. Admixtures: Include admixture types and quantities indicated in concrete mix designs only when approved by Engineer.
   1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
   2. Do not use calcium chloride or admixtures containing calcium chloride.
   3. Use set retarding admixtures during hot weather.
   4. Add air entrainment admixture to concrete mix for work exposed to freezing and thawing or deicing chemicals.
   5. For concrete exposed to deicing chemicals, limit fly ash to less than 20 percent of the combined weight of cement and fly ash.

C. Ready Mixed Concrete: Mix and deliver concrete in accordance with ASTM C94.

D. Site Mixed Concrete: Mix concrete in accordance with ACI 350.

## 2.13 CURING COMPOUNDS

A. Membrane Curing Compound: ASTM C309 Type 1, Class B.
   1. Manufacturers:
   2. Degussa Admixtures, Inc., Confilm.
   3. Euclid Chemical Co., Kurez W VOX.
   4. W. R. Meadows, Inc., 1100-Clear Series.
   5. Substitutions: Equal per EJCDC® aC-200 - Instructions to Bidders.

B. Water: Potable, not detrimental to concrete.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

## 3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Remove laitance, coatings, and unsound materials.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with epoxy.

C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

D. Remove water from areas receiving concrete before concrete is placed.

E. Earth Forms:
   1. Trench earth forms neatly, accurately, and at least 2 inches wider than footing widths indicated on Drawings.
   2. Trim sides and bottom of earth forms.
   3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
   4. Form sides of footings where earth sloughs.
   5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

F. Formwork - General:

1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

G. Forms for Smooth Finish Concrete:
1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

H. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

I. Framing, Studding and Bracing:
1. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
2. Distribute bracing loads over base area on which bracing is erected.
3. When placed on ground, protect against undermining, settlement, or accidental impact.

J. Erect formwork, shoring, and bracing to achieve design requirements in accordance with requirements of ACI 318 [ACI 301].

K. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

L. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

M. Install fillet and chamfer strips on external corners of exposed corners.

N. Install void forms in accordance with manufacturer's recommendations.

O. Do not reuse wood formwork with damaged faces or edges for concrete surfaces to be exposed to view. Do not patch formwork.

## 3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

## 3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

H. Form Ties:
   1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
   2. Place ties at least 1 inch away from finished surface of concrete.
   3. Leave inner rods in concrete when forms are stripped.
   4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless otherwise shown on Drawings.
   5. Set with waterstops.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:
1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad, or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

## 3.5 FORM CLEANING

A. Clean forms as erection proceeds to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

## 3.6 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads or removal has been approved by Engineer.

B. Leave forms in place for minimum number of days as specified in ACI 347.

C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

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

E. Twist ties off, point and patch holes with non-shrink grout within 48 hours of form removal.

## 3.7 ERECTION TOLERANCES

A. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

B. Camber slabs and beams in accordance with ACI 350.

## 3.8 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

E. Site Mock-Ups: Provide site mock-ups, at least 3 feet by 4 feet in size, of finishes of formed surfaces in exposed locations and of exposed slab finishes for the Engineer’s review and approval.

3.9 PLACEMENT

A. Place, support, and secure reinforcement against displacement. Do not deviate from required position beyond specified tolerance.
   1. Do not weld crossing reinforcement bars for assembly except as permitted by Engineer.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings.

D. Space reinforcement bars with minimum clear spacing in accordance with ACI 318.

E. Maintain concrete cover around reinforcement as indicated in Drawings with a minimum cover as follows:

| Reinforcement Location | | Minimum Concrete Cover |
|---|---|---|
| Footings and concrete formed against earth | | 3 inches |
| Concrete exposed to earth or weather | No. 6 bars and larger | 2 inches |
| | No. 5 bars and smaller | 1-1/2 inches |
| Supported slabs, walls, and joists | No. 14 bars and larger | 1-1/2 inches |
| | No. 11 bars and smaller | 3/4-inch |
| Beams and columns | | 1-1/2 inches |
| Reinforcement Location | | Minimum Concrete Cover |
| Shell and folded plate members | No. 6 bars and larger | 3/4-inch |
| | No. 5 bars and smaller | 1/2-inch |

F. Splice reinforcing only where indicated on Drawings or approved by Engineer. Splice in accordance with splicing device manufacturer's instructions.

3.10 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

| Reinforcement Depth | Depth Tolerance | Concrete Cover Tolerance |
|---|---|---|
| Greater than 8 inches | Plus or minus 3/8-inch | Minus 3/8-inch |
| Less than 8 inches | Plus or minus 1/2-inch | Minus 1/2-inch |

C. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

## 3.11 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Notify testing laboratory and Engineer minimum 48 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion, and contraction joints are not disturbed during concrete placement.

D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

F. Separate slabs on grade from vertical surfaces with 1/2 inch thick joint filler.

G. Place joint filler in slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

H. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.

I. Install construction joint devices in coordination with slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

J. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.

K. Install joint covers in longest practical length, when adjacent construction activity is complete.

L. Deposit concrete at final position. Prevent segregation of mix.

M. Place concrete in continuous operation for each panel or section determined by predetermined joints.

N. Consolidate concrete.

O. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken. Keep records on site in Contractor's office or file with Engineer.

P. Place concrete continuously between predetermined expansion, control, and construction joints.

Q. Do not interrupt successive placement; do not permit cold joints to occur.

R. Place floor slabs in pattern indicated.

S. Saw cut joints prior to concrete set. Thickness and depth as indicated on Drawings

T. Screed floors and slabs on grade level, maintaining surface flatness of maximum 1/4 inch in 10 feet.

## 3.12 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers, edge strips, reinforcing and other items to be cast in.

C. Apply bonding agent to substrate.

D. Place concrete floor toppings to required lines and levels.

E. Screed toppings level, maintaining surface flatness of maximum 1/8 inch in 10 feet.

## 3.13 CONCRETE FINISHING

A. Repair surface defects immediately after form removal. Surface defects are defined to include: form-tie holes, air voids or pockets, bug holes, honeycombed areas, rock pockets, visible construction joints, fins and burs. Repair of surface defects shall be tightly bonded and shall result in concrete surfaces of uniform color, texture, matching adjacent surfaces, and free of shrinkage cracks. Final finish shall be clean, free of bug holes and honey coming, smooth and acceptable to the engineer.

B. Areas not exposed to view (such as in contact with earth or covered with a finish) shall have a formwork surface finish -1.0 as defined in ACI 301.
   1. Patch all voids larger than 1.5” wide or 0.5” deep;
   2. Remove all projections larger than 1”;
   3. Patch tie holes. Specific project requirement more stringent than SF 1.0.

C. Areas exposed to view (including areas that will be under water inside a tank) shall have a formwork surface finish-3.0 as defined in ACI 301.
   1. Patch all voids larger than ¾” wide or ½” deep;
   2. Remove all projections larger than1/8”;
   3. Patch tie holes;
   4. Surface tolerance shall meet class A as defined in ACI 117;
      a. 1/8 in;
      b. Abrupt irregularities shall be measured within 1 in. of the irregularity; and,
      c. Gradual surface irregularities shall be measured by determining the gap between concrete and near surface of a 5 ft straightedge, measured between contact points.
   5. Provide a mockup of the concrete surface for appearance and texture; and,
   6. All formwork butt joints shall align in both horizontal and vertical directions.

D. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
    a. Apply a trowel finish to surfaces indicated exposed to view.
        1) Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15.
2. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where exterior slabs are exposed to foot traffic.
    a. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

## 3.14 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
    1. Protect concrete footings from freezing for minimum five days.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure concrete in accordance with ACI 308.1 using method approved by Engineer.

D. Maintain 100 percent coverage over floor slab areas continuously for seven days.

## 3.15 FIELD QUALITY CONTROL

A. Section 00 14 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform field inspection and testing in accordance with ACI 350.

C. Provide free access to Work and cooperate with appointed firm.

D. Reinforcement Inspection:
    1. Placement Acceptance: Specified and ACI 350 material requirements and specified placement tolerances.
    2. Welding: Inspect welds in accordance with AWS D1.1.
    3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
    4. Continuous Weld Inspection: Inspect reinforcement as required by ACI 350.
    5. Periodic Weld Inspection: Other welded connections.

E. Concrete Inspections:
    1. Continuous Placement Inspection: Inspect for proper installation procedures.

2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.

F. Strength Test Samples:
   1. Sampling Procedures: ASTM C172.
   2. Cylinder Molding and Curing Procedures: ASTM C31, cylinder specimens, standard cured or field cured.
   3. Concrete Tests: Obtain a composite sample of fresh concrete and make one set of 4 cylinders obtained in accordance with ASTM C 172 according to the following frequency:
      a. One composite sample for each day's pour of each concrete class or mixture placed, nor less than
      b. One composite sample for the first 50cy up to 100cy. Once the pour exceeds 100cy, then one sample for each 100cy after of each class or mixture placed each day, nor less than
      c. Once composite sample for each 5,000sf of slab or wall surface area of each class or mixture placed each day.
   4. When volume of concrete for any class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches or from every batch when less than five batches are used.

G. Field Testing:
   1. Slump Test Method: ASTM C143.
   2. Air Content Test Method: ASTM C173 or ASTM C231.
   3. Temperature Test Method: ASTM C1064.
   4. Measure slump and temperature for each compressive strength concrete sample.
   5. Measure air content in air entrained concrete for each compressive strength concrete sample.

H. Cylinder Compressive Strength Testing:
   1. Test Method: ASTM C39.
   2. Test Acceptance: In accordance with ACI 350.
   3. Test one cylinder at 7 days.
   4. Test one cylinder at 14 days.
   5. Test one cylinder at 28 days.
   6. Retain one cylinder for testing when requested by Engineer.
   7. Dispose remaining cylinders when testing is not required.

I. Core Compressive Strength Testing:
   1. Sampling and Testing Procedures: ASTM C42.
   2. Test Acceptance: In accordance with ACI 350.
   3. Drill three cores for each failed strength test from concrete represented by failed strength test.

J. Water Soluble Chloride Ion Concentration Test Method: ASTM C1218; tested at 28 days.
   1. Maximum Concentration: As permitted by applicable code.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

## 3.16 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed by Engineer in accordance with ACI 318.

## 3.17 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

B. Repair or replacement of defective concrete will be determined by Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

## 3.18 SCHEDULE - REINFORCEMENT

A. Reinforcement for Superstructure Framing Members: Deformed bars, unfinished.

B. Reinforcement for Foundation Wall Framing Members and Slab-on-Grade: Deformed bars and wire fabric, epoxy coated finish

END OF SECTION

SECTION 03 48 00
FIELD ERECTED PRECAST CONCRETE BUILDINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. The Contractor will furnish all labor, materials, equipment and supplies and perform all work necessary for the complete and satisfactory installation of field erected precast concrete buildings as shown on the drawings and described in these specifications.

1.2 RELATED WORK

A. Section 01 33 01- Submittal Procedures EPMS
B. Section 09 90 00 - Painting and Coating
C. Division 26 Electrical

1.3 QUALITY ASSURANCE

A. ACI-318-08, "Building Code Requirements for Reinforced Concrete, American Concrete Institute.

B. ASCE-7-05, "Minimum Design Loads for Buildings and Other Structures", American Society of Civil Engineers.

C. "Manual of Standard Practice", Concrete Reinforcing Steel Institute.

D. Local Codes and Standards for Project Location IBC 2009 / 2012 NC State Building Code.

E. UL-752 test method level 4 for bullet resistance certified by an independent structural engineer.

F. Fabricator must be a certified producer/member of The Precast/Prestressed Concrete Institute (PCI), National Precast Concrete Association (NPCA) or equal.

G. Building fabricator must have a minimum of 5 years experience manufacturing and setting transportable precast concrete buildings.

H. Lincoln County, NC Building Code

1.3 DESIGN REQUIREMENTS

A. Standard Dimensions: As noted on drawings.

B. Design Loads:

1. Seismic Design Category ‘C’, Occupancy Category, III

2. Design Roof Live Load – 20 PSF & 30 PSF Super Impression Dead Load

3. Design Wind Loading – 90 MPH, Exposure C, Iwe 1.15

C. Gabled Roof: Roof panels shall have a peak in the center and slope approximately 2”to each side. The roof shall extend a minimum of 3” beyond the wall panel all around with a turndown feature where the design extends ½” below the top edge of the wall panels to further prevent water migration into the building along top of wall panels. Roof shall also have a smooth formed edge on all four sides.

D. Roof and wall panels must each be produced as single component monolithic panels. No roof or vertical wall joints will be allowed, except at corners. Wall panels shall be set on top of bottom panel for setting on slab on grade installed by the Contractor.

E. Keyway Roof Joints: Grout in keyways shall be polymer concrete placed after coated keyways with a methyl methacrylate resin and isocyanate resin. Top of keyway coated with a primer followed by one coat of polymeric joint sealant followed by a fiberglass resin fabric followed by a second coat of polymeric joint sealant.

F. Roof, walls and floor joints shall be sealed at all joints. Wall panels shall set in ½” turn down edge of cast in place floor slab with the exterior surfaces of the wall panels aligned flush with outside edges of slab so that no wall panel overhang is allowed.

## 1.4 SUBMITTALS

A. Engineering calculations that are designed and sealed by a professional engineer, licensed to practice in the state where the project is located, shall be submitted for approval per Section 01 33 01.

B. Building layout drawings showing all door and wall openings, location and dimensions.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Items are to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

B. Handling:
   1. Buildings shall be carefully handled and protected from damage while in storage and during installation.
   2. Buildings damaged by handling or construction shall be immediately repaired or replaced to the Engineer's satisfaction.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Buildings shall be manufactured by Smith-Carolina, Reidsville, NC; AES Precast, Northport, AL; Modern Concrete Products & Construction Supplies, Ottsville, PA or equal.

2.2 MATERIALS

A. Concrete: Steel-reinforced, 5000 PSI minimum 28-day compressive strength, air-entrained (ASTM C260).

B. Reinforcing Steel: ASTM A615, grade 60 unless otherwise specified.

C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, enclosed within a greased plastic sheath, (ASTM A416). Roof and floor to be each post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners wherein the positioning of the cable member results in a pattern of one or more loops and a bisecting of the loop(s). The cable member starts from one corner of the concrete building panel, forms a gentle perimeter loop(s) returning to a point where the cable member entered the concrete building panel. The tendon then turns 90 degrees and follows the cable member(s) to a point midway along the "Y" axis of the concrete building panel and then turns 90 degrees along the "X" axis of the concrete building panel. This bisects the concrete building panel and crosses the opposite parallel portion of the cable member and exits from an adjacent side of the concrete building panel.

1. If post-tensioning is not used in the roof panel, the following guidelines must be followed to ensure a watertight roof design.

    a. The entire precast concrete roof panel surface must be cleaned and primed with a material that prepares the concrete surface for proper adherence to the coating material.

    b. The entire precast concrete roof panel surface shall be sealed with a .045 EPDM continuous membrane cemented to the concrete with a compound designed for this purpose.

D. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be Sonneborn "Sonolastic" NP-1 Limestone sealant or equal. Exterior caulk joint to be ½" x ½" square so that sides of joints are parallel for correct caulk adhesion.

D. Horizontal precast roof and floor joints shall be sealed watertight with polymer concrete grouted keyways and longitudinal post-tension.

E. Exterior wall shall be sealed for weather proofing per Section 09 90 00.

F. Ventilation: See drawing.

G. Panel Connections: All panels shall be securely fastened together with 3/8" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C and hot dipped galvanized after fabrication. All fasteners to be ½" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal. All inserts for corner connections must be secured directly to form before casting panels. No floating-in of connection inserts shall be allowed.

## 2.3 ACCESSORIES

A. Doors and Frames: Doors and frames shall be constructed of fiberglass reinforced plastic (FRP) with corrosion resistant hardware including panic door devices and closers to match opening shown on the drawings.

B. Door locks are to be keyed to match plant locks per Owner.

C. Doors shall have a minimum thickness of 1-3/4 inches with molded one piece door plate, nominal 1/8 inch thick. Thermal insulating value shall be up to "R" factor 11.

D. Fiberglass doors and fiberglass door frames have a lifetime guarantee against failure due to corrosion from the specific environment named at the time of purchase. Additionally, fiberglass doors and fiberglass door frames shall be guaranteed for ten years against failure due to materials and workmanship, including warp, separation or de-lamination, and expansion of the core.

E. Roll up doors shall be an insulated, sectional door of aluminum or fiberglass construction with corrosion resistant hardware with a minimum thermal insulating rating R-value of 14, joint seal to prevent air infiltration, locking mechanism and manual lift to match opening shown on drawings.

F. Electrical Accessories: Per electrical drawings.

G. Mechanical Accessories: Per mechanical drawings.

## 2.4 FINISHES

A. Interior of Building: Smooth steel form finish on all interior panel surfaces.

B. Exterior of Building: Architectural precast concrete to match existing precast concrete buildings on site with broom or split block finish. Manufacture shall submit options for Owner selection during shop drawings review process.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. The installation of the buildings furnished by the manufacturer shall be the responsibility of the manufacturer in accordance with the contract documents.

B. Buildings shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings.

C. Field wiring to the control panel and all other electrical installations and connections are the responsibility of the Contractor.

### 3.2 MANUFACTURER'S FIELD SERVICES

A. Building manufacturer shall furnish all instruction and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the building manufacturer shall inspect the complete installation and instruct the Owner's personnel in operation and maintenance.

### 3.3 WARRANTIES

A. The building supplier shall warranty the building and all supplied doors and related building accessories for a period of one year. The warranty period shall include the 12-month period beginning upon the date of acceptance by the Owner.

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
   2. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for surface-preparation and priming requirements.

### 1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

### 1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Tension-control, high-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Shop primers.
5. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications (The contractor must meet one of the two following requirements):
1. A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or
2. A qualified fabricator with a minimum of 5 years experience in fabricating structural steel similar to that indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the work. The fabricator shall retain, at no cost to the owner, a structural engineer

to oversee an inspection process as directed by the engineer of record. The structural engineer shall submit a summary letter and all supporting documentation to the engineer of record for approval. The letter shall be signed and sealed with an engineering seal for the same state where the project is located and must be approved by the engineer of record prior to fabrication.

a. Fully comply with exception of AISC Certification as provided by NCBC Part 1704.2.2 at the fabricator's expense.

B. Installer Qualifications: A qualified installer and experienced installer who has completed structural steel work similar in material, design, and extent to that indicated for the project and with a record of successful in-service performance for a minimum of 5 years.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering

analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.

B. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 50.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
1. Weight Class: Standard, unless otherwise noted.
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Unheaded Anchor Rods: ASTM F 1554, Grade 36 or ASTM F 1554, Grade 55, weldable.
1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

C. Threaded Rods: ASTM A 36/A 36M.
1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened carbon steel.
3. Finish: Plain.

2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: ASTM A 780/A 780M.

## 2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

## 2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.
   6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

## 2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
   3. Prepare test and inspection reports.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

## 3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

## 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

## 3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

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SECTION 05 50 00

METAL FABRICATIONS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes shop fabricated metal items.
   1. Lintels.
   2. Ledge and shelf angles.
   3. Bollards.
   4. Structural supports for miscellaneous attachments.
   5. Wall protection plates and corner guards.
   6. Anchor rods.

B. Related Sections:
   1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this section in concrete.
   2. Section 03 45 00 - Precast Architectural Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this section in precast post tensioned concrete.
   3. Section 04 20 16 – Reinforced Unit Masonry: Execution requirements for embedded anchors and attachments for metal fabrications specified by this section in masonry.
   4. Section 09 90 00 - Painting and Coating: Field applied paint finish.

### 1.2 REFERENCES

A. Aluminum Association:
   1. AA DAF-45 - Designation System for Aluminum Finishes.

B. ASTM International:
   1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
   2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
   6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   8. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.

9. ASTM A479/A479M - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
10. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
14. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
15. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
17. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
18. ASTM F436 - Standard Specification for Hardened Steel Washers.
19. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

C. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.6 - Structural Welding Code - Stainless Steel.

D. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 10 - Near-White Blast Cleaning.
4. SSPC Paint 15 - Steel Joist Shop Paint.
5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

## 1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

## 1.4 QUALITY ASSURANCE

A. Perform Work in accordance with NCDOT Division of Roads and Structures standard..

## 1.5 QUALIFICATIONS

A. Design all metal fabrications and assemblies under the direct supervision of Professional Engineer experienced in design of this Work and licensed to practice in the State of North Carolina.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.7 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Structural W-Shapes: ASTM A992.

B. Structural Shapes: ASTM A36.

C. Channels and Angles: ASTM A36.

D. Steel Plate: ASTM A36.

E. Hollow Structural Sections: ASTM A500, Grade B.

F. Steel Pipe: Schedule 40.

G. Sheet Steel: ASTM A653, Grade 33 Structural Quality, galvanized with 'A' coating class.

H. Bolts: ASTM A307; Grade A or B.
   1. Finish: Hot dipped galvanized.

I. Nuts: ASTM A563 heavy hex type.
   1. Finish: Hot dipped galvanized.

J. Washers: ASTM F436, Type 1.
   1. Finish: Hot dipped galvanized.

K. Welding Materials: AWS D1.1; type required for materials being welded.

L. Shop Primer: SSPC Paint 15, Type 1, red oxide.

M. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20, Type I Inorganic.

2.2 MATERIALS - STAINLESS STEEL

A. Bars and Shapes: ASTM A276; Type 316.

B. Tubing: ASTM A269; Type 316.

C. Pipe: ASTM A312, seamless; Type 316.

D. Plate, Sheet and Strip: ASTM A240 OR ASTM A666; Type 316.

E. Bolts, Nuts, and Washers: ASTM A354.

F. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

A. Sheet Aluminum: ASTM B209, Alloy 6061, Temper T6.

B. Bolts, Nuts, and Washers: Steel, galvanized.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 GRATING

A. Unless otherwise noted, grating shall be aluminum bar grating, or I-bar type, unless shown otherwise on the Drawings, with standard mill finish and non-slip surface and shall consist of bearing bars mechanically interlocked to cross bars. Maximum spacing of bearing bars shall be 1-3/16 inches center to center. Grating shall be designed for safe uniform load of 250 psf, with maximum deflection of ¼ inch under live load of 150 psf, unless otherwise noted. All edges and ends of grating shall have banding bars the same size as bearing bars. Grating shall be fabricated with each section weighing no more than 50pounds. Cutouts and removable sections shall be provided as shown or required.

2.5 LINTELS

A. Lintels: Steel sections, size and configuration as indicated on Drawings, length to allow 8 inches minimum bearing on both sides of opening.
   1. Exterior Locations: Galvanized.
   2. Interior Locations: Prime paint, one coat.

2.6 DOOR FRAMES

A. Door Frames: Steel channel sections, size indicated on Drawings, with jamb anchors as required for type of construction and suitable for building into masonry or attachment to concrete, with a minimum 4 anchors per jamb; prime paint, one coat.

2.7 BOLLARDS

A. Bollards: Steel pipe, concrete filled, crowned cap, 6 inches diameter, length as indicated on Drawings; prime paint, one coat.

B. Concrete Fill: 3,000 psi as specified in Section 03 30 00.

C. Anchors: Concealed type as indicated on Drawings.

2.8 STRUCTURAL SUPPORTS

A. Steel sections of shape and size required to support applied loads with maximum deflection of 1/240 of the span; prime paint, one coat.

2.9 ANCHOR RODS

A. Anchor Rods: ASTM A307; Grade A.
   1. Shape: Hooked.
   2. Furnish with nut and washer; unfinished.

2.10 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.11 FACTORY APPLIED FINISHES - STEEL

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

B. Do not prime surfaces in direct contact with concrete or where field welding is required.

C. Prime paint items with one coat except where galvanizing is specified.

D. Galvanizing: ASTM A123/A123M; hot dip galvanize after fabrication.

E. Galvanizing for Fasteners, Connectors, and Anchors:
   1. Hot-Dipped Galvanizing: ASTM A153.

2.12 FACTORY APPLIED FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: AAMA A41 anodized, prepared with chemical C pre-treatment, anodized to clear color.

B. Interior Aluminum Surfaces: AAMA A41 anodized, prepared with chemical C pre-treatment, anodized to clear color.

C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.13 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

C. Field weld components indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch for every 12 ft in height, non-cumulative.

C. Maximum Offset From Alignment: 1/4 inch.

D. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

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SECTION 05 51 33
METAL LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Specialty custom designed Ladder Rung with safety cage.

1.2 RELATED SECTIONS

A. Section - Metal Railings

1.3 REFERENCES

A. OSHA 1910, Subpart D, 1910.24 Fixed Industrial Ladders

B. OSHA 1926, Subpart X, 1926.1053 Ladders

C. US Corps of Engineers Safety and Health Requirements Manual 11 03

D. ANSI A14.3, Safety requirements for Fixed Ladders

E. AISC M016 Manual of Steel Construction, Allowed Stress Design

F. ASTM A 36/A 36M Standard Specification fro Structural Steel

G. ASTM A123 (Standard Specification fro Zinc coating - Hot Dip Galvanizing of Iron and Steel Products);

H. ASTM Z325 (Bolts, Nuts, and Washers)

I. Joint Surface Preparation, SSPC-3, Power Tool Cleaning

J. American Society for Testing and Materials (ASTM) - ASTM A36 Standard Specification for Carbon Structural Steel

K. American Iron and Steel Institute (AISI) - AISI CL 304.

L. American Welding Society Structural Welding Code (AWS) - AWS D1.1, D1.2

1.4 SYSTEM DESCRIPTION

A. Provide horizontal grab bars to assist in stepping through the top 42" portion of fixed ladders.

## 1.5 SUBMITTALS

A. General: Provide submittals in accordance with Conditions of the Contract.

B. Shop Drawings: Provide shop drawings showing layout, hardware, and finishes. Include applicable material specifications and sections detailing mounting and connections.

C. Installation: Provide installation instructions and drawings detailing installation procedure.

D. Closeout Submittals: Provide Operation and Maintenance data to include methods for maintaining installed products, precautions against cleaning materials and methods detrimental to finishes and performance.

## 1.6 QUALITY ASSURANCE

A. Experience: Manufacturer must demonstrate a minimum of Five (5) years successful experience in design and manufacture of similar related products.

B. Provide evidence to the effect, including list of installations, descriptions, name and method of contact shall be provided.

C. Welder Qualifications: Welders Certified in accordance with American Welding Society Procedures: AWS-1-GMAW-S, WPS No. B2.004.90 for applicable material used in production of specified product.

## 1.7 DELIVER, STORAGE, AND HANDLING

A. Delivery
   1. Deliver materials in manufacturer's original, unopened, undamaged shipping container with identification labels intact.

B. Storage
   1. Store all materials in a dry, controlled area to protect from elements and damage. If outdoor storage is required, block materials to store at an incline, to prevent pooling of any moisture and promote runoff.
   2. Do not tarp tightly, as this will entrap moisture. Instead, tarp materials in a tent-like arrangement, elevated above the product with open sides to allow airflow.

C. Handling
   1. Use caution when unloading and handling product to avoid bending, denting, crushing, or other damage to the product.

## 1.8 WARRANTY

A. Special Warranty
   1. Manufacturer guarantees this product and components to be free from manufacturing defects for a period of One (1) year from date of shipment.

1.9 MAINTENANCE

A. Routine inspections and maintenance (Determined by owner).

B. General housekeeping of immediate area.

C. Immediate replacement or repair of damaged or missing components.

PART 2 - PRODUCTS

2.1 MANUFACTURING

A. Product Manufacturers include: Ellis Ladder Improvements, Inc., Precision Ladders, LLC and O'Keeffe's, Inc.

B. Substitutions are permitted as referenced in Section - Instructions to Bidders.

2.2 PERFORMANCE

A. Products Details:
   1. Provide horizontal grab bars to step through ladders portion of your fixed ladders. Ladder provides personnel horizontal hand holds to ascend or descend the full height of a fixed ladder.
   2. Only horizontal grip members are reliable to sustain a fall of the body if the foot slides off the rung for any reason. If a vertical member is held, no matter what the shape of the side rail or the strength of grip, the force of falling causes the hand to slide, producing an impact with the next rail obstruction, which causes release of the handhold and a resulting fall.
   3. Material requirements: See Section 2.03 COMPONENTS.

2.3 COMPONENTS

A. Attributes
   1. Ladder to be fabricated from structural or formed steel shapes, ASTM A36; tubing, ASTM-A-500 Grade B, ASTM-A-513; bars, ASTM-A-36, M1020; of appropriate size and strength, welded construction.
   2. Finish on all exposed surfaces to be Hot Dip Galvanized, Power Coat Safety Yellow.

2.4 SOURCE QUALITY CONTROL

A. Obtain ladders from single manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Compliance: Comply with all manufacturer's product data, including installations instructions, reference drawings, shipping, handling, and storage instructions, and product carton instructions for installation.

### 3.2 INSTALLATION/APPLICATION

A. Installation
   1. Install in accordance with manufacturer's installation instructions, shop drawings, and details.
   2. All bolted connections must be tight with no fewer than two threads exposed and the nuts are to be positively locked by provide lock nuts.

B. Tolerances
   1. All dimensional requirements must be in accordance with manufacturer's installation instructions and shop drawings.

### 3.3 FIELD QUALITY CONTROL

A. Installation: Product to be installed using good general construction methods and practices, in accordance with manufacturer's instructions and drawings.

B. Field Tests/Installation Verification:
   1. Verify all anchorage is in accordance with manufacture's installation instructions and applicable data sheets.

### 3.4 CLEANING

A. Repair or replace damaged installed products or components.

B. Touch up damaged finish.

### 3.5 PROTECTION

A. Protect installed product and finish surfaces from damage during handling, storage, and installation.

B. Protect installed product and finish surfaces during normal and general use.

END OF SECTION

SECTION 05 52 00
METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel railings, balusters, and fittings.
   2. Handrails.

B. Related Requirements:
   1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.
   2. Section 04 20 00 - Unit Masonry: Execution requirements for placement of anchors, as specified in this Section, in masonry.
   3. Section 05 51 00 - Metal Stairs: Handrails other than those specified in this Section.
   4. Section 09 90 00 - Painting and Coating: Paint finish.

1.2 REFERENCE STANDARDS

A. Aluminum Association:
   1. AA ADM 1 - Aluminum Design Manual.
   2. AA ASM 35 - Aluminum Sheet Metal Work in Building Construction.

B. American Architectural Manufacturers Association:
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. ASTM International:
   1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   4. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   5. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.

D. Green Seal:
   1. GC-03 - Anti-Corrosive Paints.

E. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.
   2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
   3. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 SUBMITTALS

A. Section - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

C. Samples: Submit one 12-inch-long samples of handrail. Submit one samples of elbow, tee, wall bracket, escutcheon and end stop.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statements:
   1. Submit qualifications for fabricator and erector.
   2. Submit manufacturer's approval of fabricator and erector.

1.4 SUSTAINABLE DESIGN SUBMITTALS

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.

B. Manufacturer's Certificate: Certify that the following products meet or exceed specified sustainable design requirements.
   1. Metal Railings.

C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Salvaged, refurbished, and reused products.
      b. Products with recycled material content.
      c. Regional products.

1.5 QUALITY ASSURANCE

A. Perform Work for structural aluminum according to AA ADM 1 and AA ASM 35.

B. Perform Work of this Section according to ASTM E985.

C. Finish joints according to NOMMA Guideline 1.

## 1.6 QUALIFICATIONS

A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience and approved by manufacturer.

B. Erector: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

## 1.7 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE AND DESIGN CRITERIA

A. Design handrail, guardrail, and attachments to resist forces as required by NC Building code. Apply loads non-simultaneously to produce maximum stresses.
   1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.
   2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
   3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

## 2.2 HANDRAILS AND RAILINGS

A. Manufacturer List:
   1. Substitutions: Section: Instructions to Bidders.

## 2.3 SUSTAINABILITY CHARACTERISTICS

A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design compliance.

B. Material and Resource Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content.
   2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project Site.

C. Indoor Environmental Quality Characteristics:
   1. Paints and Coatings: Maximum volatile organic compound content according to product and testing requirements of CA/DHS/EHLB/R-174.

D. Indoor Environmental Quality Characteristics:
   1. [Interior] Anti-Corrosive Paints: Maximum volatile organic compound content according to GC-03.

## 2.4 MATERIALS

A. Steel Railing System:
   1. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
   2. Rails and Posts: 1-1/2-inch-diameter steel tubing; welded joints.
   3. Fittings: Elbows, T-shapes, wall brackets, escutcheons; cast or machined steel.
   4. Mounting: Adjustable brackets and flanges, with steel inserts for casting in concrete, and with steel brackets for embedding in masonry.
   5. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
   6. Splice Connectors: Steel welding collars.
   7. Galvanizing: According to ASTM A123; hot-dip galvanized after fabrication.
   8. Touchup Primer for Galvanized Surfaces: SSPC Paint 20, Type I - Inorganic, zinc-rich.
   9. Shop Primer: SSPC Paint 15, Type 1, red oxide; Zinc-rich inorganic primer; Moisture-cured MIO-zinc primer.
   10. Touchup Primer: Match shop primer.

## 2.5 FABRICATION

A. Fit and shop-assemble components in largest practical sizes for delivery to Site.

B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.

C. Form simple and compound curves by bending tubing in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of tubing throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.

G. Interior Components: Continuously seal joined pieces by continuous welds.

H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

I. Exposed Welded Joints: NOMMA Guideline 1.

J. Accurately form components to suit stairs and landings, to each other and to building structure.

K. Accommodate expansion and contraction of members and building movement without damage to connections or members.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that field conditions are acceptable and are ready to receive Work.

C. Verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

### 3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Clean and strip primed steel items to bare metal where Site welding is required.

C. Supply items required to be cast into concrete and embedded in masonry with setting templates to appropriate Sections.

### 3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Anchor railings to structure with anchors, plates and angles.

C. Field-weld anchors as indicated on Drawings and Shop Drawings. Touch up welds with primer. Grind welds smooth.

D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

### 3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Plumb: 1/8 inch per story, noncumulative.

C. Maximum Offset from Alignment: 1/16 inch.

D. Maximum Out-of-Position: 1/16 inch.

END OF SECTION

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SECTION 05 53 00
METAL GRATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Formed floor and stair tread gratings.
2. Flat surface floor and stair tread plating.
3. Perimeter closure.

B. Related Requirements:
1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal components as required by this Section.
2. Section 05 51 00 - Metal Stairs: Framing for grating [and stair treads].
3. Section 09 90 00 - Painting and Coating: Field-paint finishes.

1.2 REFERENCE STANDARDS

A. ASTM International:
1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
4. ASTM A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.

B. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.

C. Green Seal:
1. GC-03 - Anti-Corrosive Paints.

D. National Association of Architectural Metal Manufacturers:
1. NAAMM MBG 531 - Metal Bar Grating Manual.
2. NAAMM MBG 532 - Heavy-Duty Metal Bar Grating Manual.

E. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 10 - Near-White Blast Cleaning.
4. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
5. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with placement of frames, tolerances for placed frames.

1.4 SUBMITTALS

A. Section - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit span and deflection tables.

C. Shop Drawings: Indicate details of gratings, component supports, anchorages, perimeter construction details, and tolerances. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

D. Samples: Submit two samples, 6 by 6 inch in size, illustrating surface finish, color, and texture.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.

G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for gratings.

H. Manufacturer's Instructions: Submit special requirements of perimeter framing.

I. Qualifications Statement:
   1. Submit qualifications for licensed professional.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWS standards.

B. Maintain one copy of each standard affecting the Work of this Section on-Site.

1.6 QUALIFICATIONS

A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

1.7 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

A. Conform to applicable NC Building code for applicable loads.

B. Design Live (Pedestrian) Load: Uniform load of 100 lb./sq. ft. minimum; concentrated load of force 300 lb..

C. Maximum Allowable Deflection under Live Load: 1/240 of span; size components for single span.

D. Maximum Spacing between Bars: 3/8 inch.

### 2.2 GRATINGS AND FLOOR PLATES

A. Manufacturer List:
   1. McNichols, www.mcichols.com; All American Grating, www.aagrating.com; FSI Industries, www.fsiindustries.com
   2. Substitutions: Section 00 21 13 - Instructions to Bidders

### 2.3 MATERIALS

A. Sheet Steel for Die Stamping: ASTM A653; with raised lug pattern; galvanized to G90 coating class.

B. Crossbars: Alloy 6063T5/T52.

C. Welding Materials: type as required for materials being welded.

D. Shop Primer: SSPC Paint 15, Type 1, red oxide.

E. Touchup Primer: Match shop primer.

F. Touchup Primer for Galvanized Surfaces: SSPC Paint 20, Type I – Inorganic.

### 2.4 FABRICATION

A. Grating Type: NAAMM MBG 532, welded type.

### 2.5 FINISHES

A. Prepare surfaces to be primed according to SSPC Manual and SSPC SP 1.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Do not prime surfaces in direct contact with concrete or where field welding is required.

D. Prime-paint items with two coats.

E. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.

2.6 ACCESSORIES

A. Fasteners, Saddle Clips, Flange Blocks, J-hooks: Galvanized steel.

B. Perimeter Closure: Same material as grating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that opening sizes and dimensional tolerances are acceptable.

C. Verify that supports are correctly positioned.

3.2 INSTALLATION

A. Place frames in correct position, plumb and level.

B. Mechanically cut galvanized finish surfaces. Do not flame cut.

C. Anchor by bolting through saddle clips and bolting through flange blocks.

D. Set perimeter closure flush with top of grating and surrounding construction.

E. Secure to prevent movement.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Conform to NAAMM MBG 532.

C. Maximum Space Between Adjacent Sections: 1/8 inch.

D. Maximum Variation from Top Surface Plane of Adjacent Sections: 1/16 inch.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean welds and damaged coatings and apply two coats of touchup primer.

END OF SECTION

SECTION 05 60 00
MISCELLANEOUS METAL

PART 1. GENERAL

1.1 SUMMARY

A.

SCOPE: This section included all miscellaneous metal work as shown on the plans and as specified herein.

2. GENERAL: Miscellaneous metal items shall be fabricated and installed in strict accordance with details, shop drawings and to the ENGINEER's satisfaction. All work shall be made and erected square, plumb, straight true accurately fitted, rigid and secure, unless otherwise specified or shown. All anchors, bolts and other fasteners shall be stainless steel unless otherwise indicated and shall be provided as shown or required. Exposed welds shall be ground smooth. Aluminum surfaces in contact with dissimilar materials shall be given one coat of bituminous paint to prevent electrolysis.

2.1 Materials:

2.1.1 Structural Steel: ASTM A36

2.1.2 Aluminum: ASTM B308, ATM B209 or ASTM B221 as applicable. Aluminum shall be alloy 6061-T6, unless otherwise specified or noted on the plans.

2.1.3 Steel Pipe: ASTM A53.

2.1.4 Gray Iron Castings: ASTM A48, Class 30 unless otherwise noted. Castings shall be of uniform quality and free of defects. Ductile iron castings shall conform to ASTM A536, Grade 65-45-12.

2.1.5 Stainless Steel:

2.1.5.1 Shapes shall be AISI Type 304 or 316 in accordance with ASTM A-276.

2.1.5.2 Miscellaneous bar stock products such as pipe straps shall be 400 Series stainless steel.

2.1.5.3 Anchor bolts, nuts and washers shall be AISI Series 300 stainless steel. 2

2.1.5.4 Sheet, strip, and plates shall be ASTM A 666, Type 304 or Type 316L.

2.1.5.5 Bolts shall conform to requirements of ASTM A 320, Type 304. Nuts shall conform to requirements of ASTM A 194, Grade 8. 3) Washers shall be Type 304.

2.2 Zinc Coating: All ferrous metal specified or indicated to be zinc coated or galvanized shall be coated by the hot-dipped process in accordance with ASTM A123 or A153, as applicable.

2.3 Shop Priming: All ungalvanized ferrous metal shall be cleaned and shop primed according to conditions as specified in Section 09900.

2.4 Shop Drawings: Shall be submitted to the ENGINEER for review prior to fabrication or delivery to the job site.

3. MISCELLANEOUS METAL WORK:

3.1 Miscellaneous Structural Shapes:

Such as beams, angles, channels, plates, brackets, etc., shall be steel or aluminum where noted and shall be provided where shown on the plans or where required for a complete installation. All structural steel work shall be designed in accordance with AISC specifications.

3.2. Handrails:
Unless otherwise noted, handrails shall be 1-1/2 inch schedule 40 aluminum pipe with mill finish. All handrail surfaces exposed to view shall be smooth and free blemished. Where practicable, railings shall be in one piece for each run. All joints and connections in welded handrails shall be ground smooth without exposed fittings. Where fasteners are used, the fasteners shall be tightened so that the handrail is rigid and free of play at joints and attachments. Provisions shall be made in all exterior handrails for water drainage. Post shall be set in sleeves of the same material and caulked tightly except where other methods of mounting or anchorage are shown. Where removable handrail sections are noted, posts shall be set in sleeves without lead caulking. Wall mounted handrails shall be supported by substantial cast aluminum wall brackets spaced not more than 5 feet apart. Ends of wall rails shall be provided with 90 degree wall returns and shall be secured using suitable flanges.

3.2.1 Safety Chain shall be ¼ inch welded 304 stainless steel chain having 12 links per foot complete with bronze swivel eye snap hooks. Chain shall be attached to eyes in the handrail.

3.2.2 All handrails shall be anchored such that the installed handrail is capable of withstanding a load of at least 200 pounds applied in any direction at any point on the top rail. Stairway handrails shall be designed to resist a horizontal thrust of 50 pounds per linear foot applied at the top rail. All other handrails shall be designed to resist a horizontal thrust of 50 pounds linear foot applied at the top rail.

3.3 Grating: Unless otherwise noted, grating shall be aluminum bar grating, or I-bar type, unless shown otherwise on the Drawings, with standard mill finish and non-slip surface and shall consist of bearing bars mechanically interlocked to cross bars. Maximum spacing of bearing bars shall be 1-3/16 inches center to center. Grating shall be designed for safe uniform load of 250 psf, with maximum deflection of ¼ inch under live load of 150 psf, unless otherwise noted. All edges and ends of grating shall have banding bars the same size as bearing bars. Grating shall be fabricated with each section weighing no more than 50pounds. Cutouts and removable sections shall be provided as shown or required.

3.4 Ladder: Shall be fabricated of structural aluminum alloy 6063-T5 members. Side rails of structural aluminum ladders shall be 3/8 inch by 2 inch and spaced not less than 12 inches on center, with the ends welded tot he side rails. Extruded aluminum rungs with non-skid grooves may be provided with aluminum ladders. Ladders shall be rigidly secured to adjacent construction with supports not more than 8 feet apart. Aluminum ladders shall have mill finish.

3.4.1 Safety Cages: Shall be fabricated of the same material as ladders and shall consist of 1/4 inch X 2 inch flat bars welded or riveted together at each connection and rigidly secure to the ladder. Cages shall be formed to provide a clear diameter of 26 inches from the face of the ladder and shall start not less than 7 feet nor more than 8 feet above the base of the ladder.

3.4.2 Safety Climbing Device: Shall be the notched rail type extending the entire height of the ladder. Device shall comply with all safety regulations, codes and ordinances, and shall be the type which can be operated solely by the user. Two safety belts and sleeves shall be furnished.

3.5 Frames and Covers:
For access to utility manholes, wetwells and valves pits or vaults shall be gray iron or ductile iron castings, and shall be the heavy duty (traffic) type except where other types are indicated. Slab type frames and covers shall be the type and duty indicated complete with solid lid, flush hinges and flush lift handle as applicable. Frames and covers shall have machines bearing surfaces to prevent rocking and rattling. Unless otherwise noted, covers shall be provided with lifting holes.

3.6 Manholes Steps:
Shall be aluminum or composite plastic steel construction. Aluminum steps shall be of aluminum alloy 6061-T6 conforming to Federal Specification QQ-A-200/8. Composite plastic steel steps shall consist of a 1 /2 inch deformed

steel reinforcing rod encapsulated on a co-polymer polypropylene plastic; reinforcing rods shall conform to ASTM A615, Grade 60; and polyproylene plastic shall conform to ASTM D2146, Type II, Grade 60; and polypropylene plastic shall conform to single concentrated load of 300 pounds. Steps shall have non-skid top surfaces, and shall be designed so that the foot cannot slip off the end. Steps shall have a minimum cross sectional dimension of 1 inch and a minimum length of 10 inches. All parts of aluminum steps to be embedded in concrete or masonry shall be coated with bituminous paint or zinc chromate primer.

3.6.1 Steps: Shall be uniformly spaced at not more than 18 inches on center unless otherwise noted. Steps shall be embedded in the wall a minimum distance of 3 inches. Each step shall project a minimum of 4 inches from the wall measured from the point of embedment.

3.7 Toeboards:
Shall be provided where shown on the plans. Toeboards shall be steel or aluminum angles as noted, or aluminum extrusions of the manufacturer's standard design, 4 inches high, and securely fastened in place.

3.8 Metal Stairs:
Shall be fabricated and erected as detailed on the plans. Stairs shall be of welded and/or bolted construction and designed to carry live loads of up to 150 psf free of vibration. Treads and landings shall be non-slip checkered plate. Handrail shall be as specified elsewhere in this section, with posts welded or bolted to stringers as detailed. Steel components shall have mill finish.

3.9 Brick and Block Vents:
Shall be Andco, Sylro or equal and shall be of cast aluminum with the manufacturer's standard finish. All vents shall have aluminum insect screen.

3.10 Post Guards:
Shall be Schedule 40 steel pipe filled with grout or concrete and provided with a cap or crowned top as shown on the plans. Guards shall be set at least 2 feet deep in concrete unless otherwise shown.

3.11 Access Doors:
Shall be ¼ inch aluminum checkered plate, reinforced to withstand a live load of 300 pounds psf. Frame shall be extruded aluminum with continuous anchors; where noted, frame shall have provisions for drainage. Where door size is not indicated, minimum size shall be 2 X 2 feet. Door shall be equipped with two heavy duty hinges, torsion spring, automatic hold open devices, and snap lock with removable handle. Double leaf doors shall have a safety chain. Doors shall have standard mill finish, with bituminous coating on frames where in contact with concrete.

3.12 Checkered Floor Plate:
Shall consist of steel or aluminum checkered plate or other suitable raised pattern non slip surface. Thickness of plate shall be as indicated, excluding raised figures. Unless otherwise noted, steel checkered plate shall be galvanized and aluminum checkered plate shall be mill finished.

END OF SECTIONK

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies wood blocking, framing, sheathing, furring, nailers, sub-flooring, rough hardware, and light wood construction.

1.2 RELATED WORK:

A. Gypsum sheathing: Section - Gypsum Board Assemblies.

1.3 SUBMITTALS:

A. Submit in accordance with Section - Shop Drawings, Product Data, And Samples.

B. Shop Drawings showing framing connection details, fasteners, connections and dimensions.

C. Manufacturer's Literature and Data:
1. Submit data for lumber, panels, hardware and adhesives.
2. Submit data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plants that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

D. Manufacturer's certificate for unmarked lumber.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect lumber and other products from dampness both during and after delivery at site.

B. Pile lumber in stacks in such manner as to provide air circulation around surfaces of each piece.

C. Stack plywood and other board products so as to prevent warping.

D. Locate stacks on well drained areas, supported at least 152 mm (6 inches) above grade and cover with well-ventilated sheds having firmly constructed over hanging roof with sufficient end wall to protect lumber from driving rain.

1.5 QUALITY ASSURANCE:

A. Installer: A firm with a minimum of three (3) years' experience in the type of work required by this section.

1.6 GRADING AND MARKINGS

A. Any unmarked lumber or plywood panel for its grade and species will not be allowed. For lumber and material not normally grade marked, provide manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material meet the specified the specified requirements.

1.7 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in the text by basic designation only.

B. American Forest and Paper Association (AFPA):

NDS-15 .....National Design Specification for Wood Construction

WCD1-01.....Details for Conventional Wood Frame Construction

C. American Institute of Timber Construction (AITC):

A190.1-07 .....Structural Glued Laminated Timber

D. American Society of Mechanical Engineers (ASME):

B18.2.1-12(R2013) .....Square and Hex Bolts and Screws

B18.2.2-10 .....Square and Hex Nuts

B18.6.1-81(R2008) .....Wood Screws

E. American Plywood Association (APA):

E30-11.....Engineered Wood Construction Guide

F. ASTM International (ASTM):

A653/A653M-13.....Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process

C954-11 .....Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 inch (2.24 mm) to 0.112-inch (2.84 mm) in thickness

C1002-14 .....Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Metal Studs

D198-14 .....Test Methods of Static Tests of Lumber in Structural Sizes

F844-07a(R2013).....Washers, Steel, Plan (Flat) Unhardened for General Use

F1667-13 .....Nails, Spikes, and Staples

G. American Wood Protection Association (AWPA):

AWPA Book of Standards

H. Commercial Item Description (CID):

A-A-55615 .....Shield, Expansion (Wood Screw and Lag Bolt Self Threading Anchors)

I. Forest Stewardship Council (FSC):

FSC-STD-01-001(Ver. 4-0)FSC Principles and Criteria for Forest Stewardship

J. Environmental Protection Agency (EPA):

40 CFR 59(2014) .....National Volatile Organic Compound Emission Standards for Consumer and Commercial Products

## PART 2 - PRODUCTS

### 2.1 LUMBER

A. Unless otherwise specified, each piece of lumber must bear grade mark, stamp, or other identifying marks indicating grades of material, and rules or standards under which produced.
   1. Identifying marks are to be in accordance with rule or standard under which material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.
   2. Inspection agency for lumber approved by the Board of Review, American Lumber Standards Committee, to grade species used.

B. Lumber Other Than Structural:
   1. Unless otherwise specified, species graded under the grading rules of an inspection agency approved by Board of Review, American Lumber Standards Committee.
   2. Furring, blocking, nailers and similar items 101 mm (4 inches) and narrower Standard Grade; and, members 152 mm (6 inches) and wider, Number 2 Grade.

C. Sizes:
   1. Conforming to PS 20.
   2. Size references are nominal sizes, unless otherwise specified, actual sizes within manufacturing tolerances allowed by standard under which produced.

D. Moisture Content:
   1. Maximum moisture content of wood products is to be as follows at the time of delivery to site.
      a. Boards and lumber 50 mm (2 inches) and less in thickness: 19 percent or less.

b. Lumber over 50 mm (2 inches) thick: 25 percent or less.

E. Preservative Treatment:
1. Do not treat Heart Redwood and Western Red Cedar.
2. Treat wood members and plywood exposed to weather or in contact with plaster, masonry or concrete, including framing of open roofed structures; sills, sole plates, furring, and sleepers that are less than 610 mm (24 inches) from ground; nailers, edge strips, blocking, crickets, curbs, cant, vent strips and other members provided in connection with roofing and flashing materials.
3. Treat other members specified as preservative treated (PT).
4. Preservative treat by the pressure method complying with AWPA Book use category system standards U1 and T1, except any process involving the use of Chromated Copper Arsenate (CCA) or other agents classified as carcinogenic for pressure treating wood is not permitted.

2.2 PLYWOOD:

A. Comply with PS 1.

B. Bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of plywood which identifies compliance by veneer grade, group number, span rating where applicable, and glue type.

2.3 ROUGH HARDWARE AND ADHESIVES

A. Anchor Bolts:
1. ASME B18.2.1 and ASME B18.2.2 galvanized, 13 mm (1/2 inch) unless shown otherwise.
2. Extend at least 203 mm (8 inches) into masonry or concrete with ends bent 50 mm (2 inches).

B. Miscellaneous Bolts: Expansion Bolts: C1D A-A-55615; lag bolt, long enough to extend at least 65 mm (2-1/2 inches) into masonry or concrete. Provide 13 mm (1/2 inch) bolt unless shown otherwise.

C. Washers
1. ASTM F844.
2. Provide zinc or cadmium coated steel or cast iron for washers exposed to weather.

D. Screws:
1. Wood to Wood: ASME B18.6.1 or ASTM C1002.
2. Wood to Steel: ASTM C954, or ASTM C1002.

E. Nails:
1. Size and type best suited for purpose unless noted otherwise. Provide aluminum-alloy nails, plated nails, or zinc-coated nails, for nailing wood work exposed to weather and on roof blocking.
2. ASTM F1667:
a. Common: Type I, Style 10.
b. Concrete: Type I, Style 11.

c. Barbed: Type I, Style 26.
d. Underlayment: Type I, Style 25.
e. Masonry: Type I, Style 27.
f. Provide special nails designed for use with ties, strap anchors, framing connectors, joists hangers, and similar items. Nails not less than 32 mm (1-1/4 inches) long, 8d and deformed or annular ring shank.
g. Strap long enough to extend onto three joists or rafters, and punched for spiking at each bearing.
h. Strap not less than 101 mm (4 inches) embedded end.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS

A. Conform to applicable requirements of the following:
1. AFPA NDS for timber connectors.
2. AITC A190.1 Timber Construction Manual for heavy timber construction.
3. AFPA WCD1 for nailing and framing unless specified otherwise.
4. APA for installation of plywood or structural use panels.
5. TPI for metal plate connected wood trusses.

B. Fasteners:
1. Nails.
a. Nail in accordance with the Recommended Nailing Schedule as specified in AFPA WCD1 where detailed nailing requirements are not specified in nailing schedule. Select nail size and nail spacing sufficient to develop adequate strength for the connection without splitting the members.
b. Use special nails with framing connectors.
c. Use 8d or larger nails for nailing through 25 mm (1 inch) thick lumber and for toe nailing 50 mm (2 inch) thick lumber.
d. Use 16d or larger nails for nailing through 50 mm (2 inch) thick lumber.
e. Select the size and number of nails in accordance with the Nailing Schedule except for special nails with framing anchors.
2. Bolts:
a. Fit bolt heads and nuts bearing on wood with washers.
b. Countersink bolt heads flush with the surface of nailers.
c. Embed in concrete and solid masonry or provide expansion bolts. Special bolts or screws designed for anchor to solid masonry or concrete in drilled holes may be used.
d. Provide toggle bolts to hollow masonry or sheet metal.
3. Power actuated drive pins may be provided where practical to anchor to solid masonry, concrete, or steel.
4. Do not anchor to wood plugs or nailing blocks in masonry or concrete. Provide metal plugs, inserts or similar fastening.
5. Screws to Join Wood:
a. Where shown or option to nails.
b. ASTM C1002, sized to provide not less than 25 mm (1 inch) penetration into anchorage member.

c. Spaced same as nails.

C. Cut notch, or bore in accordance with AFPA WCD1 passage of ducts wires, bolts, pipes, conduits and to accommodate other work. Repair or replace miscut, misfit or damaged work.

D. Blocking Nailers, and Furring:
   1. Install furring, blocking, nailers, and grounds where shown.
   2. Provide longest lengths practicable.
   3. Layers of Blocking or Plates:
      a. Stagger end joints between upper and lower pieces.
      b. Nail at ends and not over 610 mm (24 inches) between ends.
      c. Stagger nails from side to side of wood member over 127 mm (5 inches) in width.

E. Fabricate roof edge vent strips with 6 mm by 6 mm (1/4 inch by 1/4 inch) notches, 101 mm (4 inches) on center, aligned to allow for venting of insulating concrete and venting base sheet. Option: Texture 1-11 plywood with parallel grooves 101 mm (4 inches) o.c. may be used.

F. Unless otherwise shown, provide wall furring 25 mm by 75 mm (1 inch by 3 inch) continuous wood strips installed plumb on walls, using wood shims where necessary so face of furring forms a true, even plane. Space furring not over 406 mm (16 inches) on centers, butt joints over bearings and rigidly secure in place. Anchor furring on 406 mm (16 inches) centers.

END OF SECTION

SECTION 07 13 25
SELF-ADHERING SHEET WATEPROOFING

PART 1 — GENERAL

1.01 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.02 SUMMARY

A. The work of this section includes, but is not limited to, the following:

1. Rubberized asphalt sheet membrane waterproofing
2. Prefabricated drainage composite
3. Protection board

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 04 20 00 – Unit Masonry
3. Section 07 11 00 – Dampproofing
4. Section 07 60 00 – Flashing and Sheet Metal
5. Section 07 92 00 – Joint Sealants
6. Section 07 95 00 – Expansion Control
7. Section 33 46 00 – Subdrainage

1.03 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. American Society for Testing and Materials (ASTM)

C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course

D 412 Standard Test Methods for Rubber Properties in Tension

D 570 Standard Test Method for Water Absorption of Plastics

D 882 Standard Test Methods for Tensile Properties of Thin Plastic Sheeting

D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

D 1876 Standard Test Method for Peel Release of Adhesives (T-Peel)

D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

D 3767 Standard Practice for Rubber - Measurements of Dimensions

D 5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes

E 96 Standard Test Methods for Water Vapor Transmission of Materials

E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

## 1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations. Include certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.

B. Samples: Submit representative samples of the following for approval:

1. Sheet membrane
2. Protection board
3. Prefabricated drainage composite

## 1.05 QUALITY ASSURANCE

A. Manufacturer: Sheet membrane waterproofing shall be manufactured and marketed by a firm with a minimum of 20 years experience in the production and sales of self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer: A firm which has at least 3 years experience in work of the type required by this section.

C. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

## 1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
2. Protect mastic and adhesive from moisture and potential sources of ignition.

3. Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.07 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.08 WARRANTY

A. Sheet Membrane Waterproofing: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

PART 2 — PRODUCTS

2.01 MATERIALS

A. Sheet Membrane Waterproofing: Equal or similar to Bituthene® 3000/Low Temperature Membrane by Grace Construction Products; a self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film. Provide rubberized asphalt membrane covered with a release sheet, which is removed during installation. No special adhesive or heat shall be required to form laps.

B. Sheet Membrane Waterproofing

PHYSICAL PROPERTIES FOR BITUTHENE 3000/LOW TEMPERATURE MEMBRANE:

| Property | Test Method | Typical Value |
|---|---|---|
| Color | | Dark gray-black |
| Thickness | ASTM D 3767 Method A | 1.5 mm (0.060 in.) nominal |
| Flexibility, 180° bend over 25 mm (1 in.) mandrel at -43°C (-45°F) | ASTM D 1970 | Unaffected |
| Tensile Strength, Membrane Die C | ASTM D 412 Modified[1] | 2240 kPa (325 lbs/in.$^2$) minimum |
| Tensile Strength, Film | ASTM D 882 Modified[1] | 34.5 MPa (5,000 lbs/in.$^2$) minimum |
| Elongation, Ultimate Failure of Rubberized Asphalt | ASTM D 412 Modified[1] | 300% minimum |
| Crack Cycling at -32°C (-25°F), 100 Cycles | ASTM C 836 | Unaffected |
| Lap Adhesion at Minimum Application Temperature | ASTM D 1876 Modified[2] | 700 N/m (4 lbs/in.) – Bituthene 3000<br>880 N/m (5 lbs/in.) – Low |

| | | |
|---|---|---|
| | | Temp |
| Peel Strength | ASTM D 903 Modified[3] | 1576 N/m (9 lbs/in.) |
| Puncture Resistance, Membrane | ASTM E 154 | 222 N (50 lbs) minimum |
| Resistance to Hydrostatic Head | ASTM D 5385 | 60 m (200 ft) of water |
| Permeance | ASTM E 96, Section 12 – Water Method | 2.9 ng/m$^2$sPa (0.05 perms) maximum |
| Water Absorption | ASTM D 570 | 0.1% maximum |

*Footnotes:*

1. *The test is run at a rate of 50 mm (2 in.) per minute.*
2. *The test is conducted 15 minutes after the lap is formed and run at a rate of 50 mm (2 in.) per minute at -4°C (25°F).*
3. *The 180° peel strength is run at a rate of 300 mm (12 in.) per minute.*

C. Protection Board:

1. Expanded Polystyrene Protection Board: 25 mm (1 in.) thick for vertical applications with the following characteristics. Adhere to waterproofing membrane with Protection Board Adhesive.

   Normal Density: 16 kg/m$^3$ (1.0 lb/ft$^3$)

   Thermal Conductivity, K factor: 0.24 at 5°C (40°F), 0.26 at 24°C (75°F)

   Thermal Resistance, R-Value: 4 per 25 mm (1 in.) of thickness.

2. Asphalt Hardboard: A premolded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 in.) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 in.) thick hardboard or one layer of 6 mm (0.25 in.) thick hardboard.

D. Waterstop: Adcor™ ES hydrophilic non-bentonite waterstop by Grace Construction Products for non-moving concrete construction joints.

E. Foundation Drain Pipe System:

1. Drain pipe around enclosing walls below grade, where called for on the drawings, shall be 4" diameter, perforated PVC drainage pipe, surrounded by polystyrene drainage bed enclosed in plastic netting; EEE-ZZZ Lay Drain Pipe Co., PO Box 867, Pisgah Forest, NC 28768 or equal. Pipe shall be laid and graded for flow as called for on drawings.

2. Laterals from drain pipe to termination points shall be standard strength, 4" diameter, Schedule 40 PVC pipe, laid with continuous grade on earth and joined with solvent welded joints. Drainage pipe sections shall be straight and free from imperfections or obstructions.

3. Cover total drain pipe with continuous strips of glass filter fabric. After drain lines have been installed, they shall be tested by running water through them. Remove all obstructions to flow.

4. Fill from top of drain pipe to backfill subgrade line with clean earth tamped firmly in place.

E. Miscellaneous Materials: Surface conditioner, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

## PART 3 — EXECUTION

### 3.01 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

### 3.02 PREPARATION OF SUBSTRATES

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Cast-In-Place Concrete Substrates:

1. Do not proceed with installation until concrete has properly cured and dried (minimum 7 days for normal structural concrete and minimum 14 days for lightweight structural concrete).
2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
4. Remove scaling to sound, unaffected concrete and repair exposed area.
5. Grind irregular construction joints to suitable flush surface.

C. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.

D. Wood Substrates: Apply waterproofing membrane over securely fastened sound surface. All joints and fasteners shall be flush to create a smooth surface.

E. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

### 3.03 INSTALLATION

A. Refer to manufacturer's literature for recommendations on installation, including but not limited to, the following:

1. Apply primer at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of primer.
2. Delay application of membrane until primer is completely dry. Dry time will vary with weather conditions.
3. Seal daily terminations with troweled bead of mastic.
4. Apply protection board and related materials in accordance with manufacturer's recommendations.

## 3.04 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.

B. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 07 17 00
BENTONITE WATERPROOFING

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Bentonite clay waterproofing in panel form.
   2. Drainage panels and protective cover.

B. Related Requirements:
   1. Section 07 21 13 - Board Insulation: Rigid insulation protective cover.
   2. Section 07 62 00 - Sheet Metal Flashing and Trim: Sheet metal work, flashing, and trim associated with roofing and waterproofing membranes.
   3. Section 33 41 13 - Foundation Drainage.
   4. Section 07 90 00 – Joint Protection: Grouting joints of precast concrete deck surfaces.

### 1.2 REFERENCE STANDARDS

A. National Roofing Contractors Association:
   1. NRCA - The NRCA Waterproofing Manual.

### 1.3 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

C. Review Project conditions that will influence the integrity of the waterproofing assembly and work of other trades affected by the waterproofing installation.

### 1.4 SUBMITTALS

A. Section - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit product criteria, characteristics, accessories, jointing and seaming methods, and termination conditions.

C. Shop Drawings: Indicate details and locations of required flashings, control and expansion joints, sealing at openings, projections, penetrations, reglets, and waterproofing of holes, slots and sleeves.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Instructions: Submit special preparation of substrate, panel attachment methods, and perimeter conditions requiring attention.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:
   1. Submit qualifications for manufacturer and installer.
   2. Submit manufacturer's approval of installer.

1.5 QUALITY ASSURANCE

A. Perform Work according to NRCA Waterproofing Manual.

B. Maintain one copy of each standard affecting the Work of this Section on-Site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 MOCKUPS

A. Section 01 40 00 - Quality Requirements: Requirements for mockups.

B. Construct mockup 100 sq. ft. of vertical waterproofed panel to represent finished Work, including internal and external corners, sealing, drainage panel, base flashings, counterflashings, protective cover, and control and expansion joints.

C. Locate where directed by Architect/Engineer.

D. Remove mockup when directed by Architect/Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging, including application instructions.

B. Maintain bentonite products dry.

C. Protection: Protect with waterproof cover. Store on blocking to prevent ground moisture contact.

D. Maintain minimum ambient storage temperatures of 40 degrees F for bentonite gel products.

1.9 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application.

1.10 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements of surfaces scheduled for waterproofing prior to installation. Indicate field measurements on Shop Drawings.

## 1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish two-year installer's warranty for waterproofing failing to resist penetration of water.

C. Furnish 10-year manufacturer's warranty for waterproofing failing to resist penetration of water.

D. For warranty repair work, remove and replace materials concealing waterproofing.

# PART 2 PRODUCTS

## 2.1 PERFORMANCE AND DESIGN CRITERIA

A. Waterproofing System: Capable of resisting water head of 10 feet and preventing moisture migration to interior.

## 2.2 BENTONITE WATERPROOFING

A. Manufacturer List:
   1. Carlisle, www.carlisleccw.com; Mar-Flex Waterproofing, www.mar-flex.com; TegraSea, www.tegraseal.com; CETCO, www.ceetco.com
   2. Substitutions: Section 00 21 13 - Instructions to Bidders.

## 2.3 MATERIALS

A. Bentonite: Granulated, pure, dry, self-expanding bentonite clay comprised of 90 percent minimum sodium montmorillonite; 90 percent minimum passing No. 20 mesh sieve and 10 percent maximum passing No. 200 mesh sieve.

B. Single Panels: Single corrugated core, smooth-faced kraft paper panels, core filled with self-expanding bentonite clay granules:
   1. Nominal Panel Size: 48 by 48 by 3/16 inches.
   2. Minimum Bentonite Fill: 1 lb./sq. ft..
   3. Minimum Panel Weight: 18 lb.

C. Joint Packing: Water-soluble plastic tube filled with bentonite clay granules; 2-inch diameter by 24 inches long.

D. Joint and Detail Mastic: Moist and hydrated bentonite clay gel using [water and glycol for below-freezing application] [and] [water for above-freezing application].

## 2.4 ACCESSORIES

A. Fasteners: Galvanized nails.

B. Adhesive: Manufacturer-recommended type.

C. Polyethylene Sheet: 4-mil thick.

D. Flexible Flashings:
   1. Self-adhered type.
   2. Furnished by bentonite panel manufacturer.

E. Protection Board: Rigid insulation as specified in Section 07 21 13 - Board Insulation.

F. Protection Board: Type as recommended by manufacturer.

G. Protection Board: 1/2-inch-thick biodegradable hardboard, bitumen-impregnated glass fiberboard.

H. Drainage Panel: 1/4-inch-thick molded, flexible rubber sheet with filter fabric.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that substrate surfaces are smooth and durable and are free of frozen matter, standing water, or foreign matter detrimental to application of waterproofing system.

C. Verify that items penetrating surfaces to receive waterproofing are securely installed.

### 3.2 PREPARATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.

B. Clean and prepare surfaces to receive waterproofing.

C. Remove concrete fins, projections, and form ties.

D. Fill holes, cracks, honeycombs, and voids with non-shrink cementitious grout; trowel level with monolithic wall surface.

E. Seal construction joints, grouted holes and voids with joint and detail mastic, minimum 1/8 inch thick and extending 3 inches beyond joints and filled holes and voids.

F. Seal all vertical inside corners with continuous 3/4-inch fillet of joint and detail mastic.

### 3.3 INSTALLATION

A. Conform to NRCA Waterproofing Manual drawing details as follows:

B. Vertical Surfaces:
   1. Apply single layer of bentonite panels with adhesive, starting at base of foundation.

2. Fold and secure panels around corners with vertical corrugations; secure unfolded panels with horizontal corrugations.
3. Cut panels at bottom to lap minimum 12 inches onto surface of footing.
4. Lap adjoining panels 6 inches; lap horizontal joints shingle-style.
5. Stagger vertical joints at mid-panel on succeeding courses.
6. Cut panels parallel to corrugations to prevent bentonite loss.
7. Place joint packing continuous at termination of panels and at protrusions or penetrations; secure to prevent movement.
8. Termination:
    a. Terminate panels 6 inches below finish grade elevation.
    b. Apply continuous strip of manufacturer's self-adhered flashing membrane and detail mastic over top edge of bentonite panel, lapped 4 inches at end joints and over top of bentonite panels.

## 3.4 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Do not permit traffic over unprotected or uncovered waterproofing.

C. Temporary Sheeting:
    1. Protect installed waterproofing from precipitation or ground water with temporary polyethylene sheeting.
    2. When backfilling begins, remove sheeting.

## 3.5 ATTACHMENTS

A. Foundation Wall: Single-panel waterproofing, one additional panel at inside and external corners.

B. Subgrade Tunnel: Triple-panel waterproofing on walls and roof; two additional panels at external corners; protection boards at all waterproofed surfaces.

END OF SECTION

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SECTION 07 19 00

WATER REPELLENTS

PART 1 -

PART 2 - GENERAL

2.1 SUMMARY

A. Section Includes: Water repellent coating applied to exterior/interior concrete masonry surfaces.

B. Related Sections:
Section 04 22 00 – Concrete Unit Masonry: Substrate for application of water repellent.
Section 09 90 00 – Painting: Primer for masonry stain and elastomeric applications, if applicable.

2.2 SUBMITTALS

A. Certifications: Submit manufacturer's certification of conformance to specified surface preparation and application rates.

B. Test Results: Submit test results of initial and final RILEM test and final spray test.

C. Contract Closeout Submittals: Submit Letter of Certification under provisions of appropriate close out section.

2.3 QUALITY ASSURANCE

A. Qualifications: Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
Applicator: Company specializing in performing the work of this Section with minimum 5 years documented experience.

B. Regulatory Requirements: Comply with applicable rules and regulations of Pollution-Control Regulatory Agency having jurisdiction regarding volatile organic compounds (VOC) and use of hydrocarbon solvents.

C. Field Samples:
Prior to water repellent application, apply water repellent coating to field mock-up sample.
Apply water repellent at an initial rate of application as determined by the manufacturer as presumed necessary to pass the RILEM water tube uptake test results specified.
Allow seven days for the sample to cure. Perform a RILEM water tube uptake test on the treated area conducted by or supervised by the manufacturer's representative. Place one tube on the block surface and one tube on a mortar joint.
Results: Absorption shall be not less than 1.0 milliliter of water using a RILEM water uptake tube at 60 mph wind driven rain equivalent. Apply additional repellent when tests results indicate failing results and retest until passing tests are achieved.
Coverage rate for entire project shall be that which is used to for the mock-up sample passing test.

2.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Materials and Equipment: Transport, handle, store, and protect products.

B. Protect coating liquid from freezing.

2.5 PROJECT CONDITIONS

A. Environmental Requirements: Do not apply Product during the following conditions:
Both ambient and surface temperatures are below 40 degrees F.
Substrate surfaces have cured less than 30 days.
Rain or temperatures below 40 degrees F are predicted for a period of 24 hours.
Surface moisture readings as measured by an electronic moisture meter exceed 20%.

1.6 WARRANTY

General contractor must provide a written manufacture's warranty prior to project completion. Said warranty from manufacturer will include replacement of materials and labor to repair any deficiencies reported for a period of no less than ten (10) years. Said warranty must be in writing from the coatings manufacturer. Applicator must provide a one year performance and workmanship warranty for one year.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

A. Subject to compliance with project requirements, the following manufacturer may be used.

Rainguard International, Newport Beach, CA 888-765-7070.

3.2 MATERIALS
Description: Clear penetrating water repellent comprising of silane, siloxane, blends of silane and siloxanes, waterborne and VOC compliant.

A. Products:

B. Rainguard: Micro-Seal Ready to Use

PART 4 - EXECUTION

4.1 EXAMINATION

A. Examine surfaces and adjacent areas where products will be applied and verify that surfaces conform to specifications and manufacturer's requirements for substrate conditions. Do not proceed until satisfactory conditions have been corrected.

B. Verify joint sealants are installed and cured.

C. Beginning of application indicates acceptance of substrate conditions.

4.2 PREPARATION

A. Surface cracks, holes, or other imperfections that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.

B. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect coating.

C. Scrub and rinse surfaces with water, and let dry.

D. Protect adjacent surfaces not scheduled to receive coating. If applied on unscheduled surfaces, remove immediately, by approved method.

E. Protect landscaping, property, and vehicles from over spray and drift.

4.3 APPLICATION

A. Do not apply until masonry mortar is cured for seven days.

B. Apply coating in accordance with manufacturer's published instructions, using appropriate method and coverage rate.

4.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a manufacturer-authorized technical service representative to inspect and approve the substrate before application, to instruct the applicator on the product and application method to be used, and to field test the in-place surfaces after application.

B. Spray Test: After water repellent has dried, spray coated surfaces with water. After surfaces have adequately dried, recoat surfaces that show water absorption.

C. Water Uptake Test: Perform a RILEM Water Uptake test on a minimum of 10 locations on the completed project to confirm conformance to minimum results stated in Part 1 hereinbefore. Conduct test on upper and lower portions of the masonry surfaces and on an equal number of joints and block surfaces. Tests shall be conducted by the manufacturer’s representative.

D. Furnish written certification that surface preparation and rate of application is completed in accordance with specification requirements and the manufacturer’s recommendations. Furnish results of in-place RILEM and spray test.

4.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces soiled or damaged by water repellent application as work progresses.

B. Repair damage caused by water repellent application.

C. Comply with manufacturer's published instructions for cleaning.

END OF SECTION

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SECTION 07 21 13
THERMAL INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Thermal insulation.
    a. Batt or blanket insulation at exterior framed walls and roof framing.
    b. Board or block insulation at floor assemblies above unconditioned spaces.

### 1.2 RELATED REQUIREMENTS

A. Insulating Precast Concrete: Section – Cast In Place Concrete.

### 1.3 APPLICABLE PUBLICATIONS

A. Comply with references to extent specified in this section.

B. ASTM International (ASTM):

1. C552-15 - Cellular Glass Thermal Insulation.
2. C1002-14 - Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
3. E84-15a - Surface Burning Characteristics of Building Materials.
4. F1667-15 - Driven Fasteners: Nails, Spikes, and Staples.

### 1.4 SUBMITTALS

A. Submittal Procedures: Section - Shop Drawings, Product Data, and Samples.

B. Submittal Drawings:

1. Show insulation type, thickness, and R-value for each location.

C. Manufacturer's Literature and Data:

1. Description of each product.

D. Sustainable Construction Submittals:

1. Recycled Content: Identify post-consumer and pre-consumer recycled content percentage by weight.
2. Low Pollutant-Emitting Materials:
    a. Show volatile organic compound types and quantities.

### 1.5 DELIVERY

A. Deliver products in manufacturer's original sealed packaging.

B. Mark packaging, legibly. Indicate manufacturer's name or brand, type, production run number, and manufacture date.

C. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.6 STORAGE AND HANDLING

A. Store products indoors in dry, weathertight facility.

B. Protect products from damage during handling and construction operations.

C. Protect foam plastic insulation from UV exposure.

1.7 WARRANTY

A. Construction Warranty: Contractor's one year labor and material warranty.

PART 2 - PRODUCTS

2.1 INSULATION - GENERAL

A. Insulation Thickness:

1. Provide thickness required by R-value shown on drawings.

B. Insulation Types:

1. Provide one insulation type for each application.

2.2 THERMAL INSULATION

A. Semi Rigid, Batts and Blankets:

1. Widths and lengths to fit tight against framing.
2. Mineral Fiber Batt or Blankets: ASTM C665 FSK faced.
3. Maximum Surface Burning Characteristics: ASTM E84.
    a. Flame Spread Rating: 25.
    b. Smoke Developed Rating: 450.

2.3 ACCESSORIES

A. Fasteners:

1. Staples or Nails: ASTM F1667, zinc-coated, size and type to suit application.
2. Screws: ASTM C954 or ASTM C1002, size and length to suit application with washer minimum 50 mm (2 inches) diameter.
3. Impaling Pins: Steel pins with head minimum 50 mm (2 inches) diameter.
    a. Length: As required to extend beyond insulation and retain cap washer when washer is placed on pin.

b. Adhesive: Type recommended by manufacturer to suit application.

B. Tape:

1. Pressure sensitive adhesive on one face.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

C. Clean substrates. Remove contaminants capable of affecting subsequently installed product's performance.

### 3.2 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions and approved submittal drawings.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for Architect’s review.

B. Install insulation with vapor barrier facing the heated side, unless indicated otherwise.

C. Install board insulation with joints close and flush, in regular courses, and with end joints staggered.

D. Install batt and blanket insulation with joints tight. Fill framing voids completely.
Seal penetrations, terminations, facing joints, facing cuts, tears, and unlapped joints with tape.

E. Fit insulation tight against adjoining construction and penetrations, unless indicated otherwise.

### 3.3 THERMAL INSULATION

A. Perimeter Insulation In Contact with Soil:

1. Horizontal insulation under concrete floor slab:

a. Lay insulation boards and blocks horizontally on level, compacted and drained fill.

b. Extend insulation from foundation walls towards center of building minimum 600 mm (24 inches).

B. Exterior Framing or Furring Insulation:

1. General:

a. Open voids are not acceptable.

b. Pack insulation around door frames and windows, in building expansion joints, door soffits, and other voids.

c. Pack behind outlets, around pipes, ducts, and services encased in walls.

d. Hold insulation in place with pressure sensitive tape.

e. Lap facing flanges together over framing for continuous surface. Seal penetrations through insulation and facings.

2. Metal Studs:

a. Fasten insulation between metal studs, framing, and furring with pressure sensitive tape continuous along flanged edges.

3. Roof Rafters and Floor Joists:

a. Friction fit insulation between framing to provide minimum 50 mm (2 inch) air space between insulation and roof sheathing and subfloor.

4. Ceilings and Soffits:

a. Metal Framing:

1) Fasten insulation between metal framing with pressure sensitive tape continuous along flanged edges.

2) At metal framing and ceilings suspension systems, install insulation above suspended ceilings and metal framing at right angles to main runners and framing.

3) Tape insulation tightly together without gaps. Cover metal framing members with insulation.

b. Ceiling Transitions:

1) In areas where suspended ceilings transition to structural ceiling, install blanket or batt insulation.

2) Extend insulation from suspended ceiling to underside of structure above.

3) Secure blanket and batt with continuous cleats to structure above.

## 3.4 PROTECTION

A. Protect insulation from construction operations.

B. Repair damage.

END OF SECTION

SECTION 07 22 00
ROOF AND DECK INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

B. Roof and deck insulation, and cover board on new concrete substrates ready to receive roofing or waterproofing membrane.

### 1.2 CONSTRUCTION REQUIREMENTS

A. Wood Cants, Blocking, and Edge Strips: Section 06 10 00, Rough Carpentry.

### 1.3 APPLICABLE PUBLICATIONS

A. ASTM International (ASTM):

1. C1289-15 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
2. E84-15a - Surface Burning Characteristics of Building Materials.
3. F1667-15 - Driven Fasteners: Nails, Spikes, and Staples.

B. National Roofing Contractors Association (NRCA):

1. Manual-15 - The NRCA Roofing Manual: Membrane Roof Systems.

C. UL LLC (UL):

1. Listed - Online Certifications Directory.

### 1.4 SUBMITTALS

A. Submittal Procedures: Section - Shop Drawings, Product Data, And Samples.

B. Submittal Drawings:

1. Show size, configuration, and installation details.
   a. Nailers, cants, and terminations.
   b. Layout of insulation showing slopes, tapers, penetrations, and edge conditions.

C. Manufacturer's Literature and Data:

1. Description of each product.

D. Samples:

1. Roof insulation, each type.
2. Fasteners, each type.

### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Same installer as Division 07 roofing section installer.

1.6 DELIVERY

A. Comply with recommendations of NRCA Manual.

B. Deliver products in manufacturer's original sealed packaging.

C. Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.

D. Before installation, return or dispose of products within distorted, damaged, or opened packaging.

1.7 STORAGE AND HANDLING

A. Comply with recommendations of NRCA Manual.

B. Store products indoors in dry, weathertight facility.

C. Protect products from damage during handling and construction operations.

1.8 FIELD CONDITIONS

A. Environment:

1. Install products when existing and forecasted weather permit installation according to manufacturer's instructions.

1.9 WARRANTY

A. Manufacturer's Warranty: Warrant insulation, and cover board against material and manufacturing defects as part of Division 07 roofing system warranty.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Insulation Thermal Performance:

1. Any Location R-Value: RSI-17 (R-10), minimum.

B. Fire and Wind Uplift Resistance: Provide roof insulation complying with requirements specified in Division 07 roofing section.

C. Insulation on Concrete Decking: UL labeled indicating compliance with one of the following:

1. UL Listed.

2. Insulation Surface Burning Characteristics: When tested according to ASTM E84.

a. Flame Spread Rating: 75 maximum.

b. Smoke Developed Rating: 150 maximum.

2.2 PRODUCTS - GENERAL

A. Provide each product from one manufacturer.

2.3 ADHESIVES

A. Primer: ASTM D41/D41M.

B. Full-Spread Applied Urethane Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to adhere roof insulation to substrate or to another insulation layer.

2.4 ROOF AND DECK INSULATION

A. Roof and Deck Insulation, General: Preformed roof insulation boards approved by roofing manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, faced with glass fiber reinforced cellulosic felt facers on both major surfaces of the core foam.

C. Tapered Roof Insulation System:

1. Fabricate of polyisocyanurate. Use only one insulation material for tapered sections. Use only factory-tapered insulation.
2. Cut to provide high and low points with crickets and slopes as shown.
3. Minimum thickness of tapered sections; 38 mm (1-1/2 inch).
4. Minimum slope 1/48 (1/4 inch per 12 inches).

2.5 INSULATION ACCESSORIES

A. Cants and Tapered Edge Strips:

1. Wood Cant Strips: Refer to Section 06 10 00, ROUGH CARPENTRY.

B. Cover Board:

1. Cellulosic-Fiber-Reinforced, Water-Resistant Gypsum Roof Board: ASTM C1278/C1278M, 13 mm (1/2 inch) thick.

2.6 ACCESSORIES

A. Fasteners: Corrosion-resistant carbon steel fasteners and galvalume-coated steel or plastic round plates for fastening substrate board and insulation to roof deck.

B. Nails: ASTM F1667; type to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Comply with requirements of Division 07 roofing section.

3.2 PREPARATION

A. Examine and verify substrate suitability for product installation.

B. Protect existing construction and completed work from damage.

3.3 INSTALLATION - GENERAL

A. Install products according to manufacturer's instructions.

1. When manufacturer's instructions deviate from specifications, submit proposed resolution for architect’s review.

B. Attach products to meet requirements of Division 07 roofing section.

3.4 INSULATION INSTALLATION

A. Insulation Installation, General:

1. Cant Strips: Install wood cant strips specified in Section 06 10 00 Rough Carpentry at junctures of roofing system with vertical construction.
2. Use same insulation as existing for roof repair and alterations unless specified otherwise.

B. Insulation Thickness:

1. Thickness of roof insulation shown on drawings is nominal. Provide thickness required to comply with specified thermal performance.
2. When actual insulation thickness differs from drawings, coordinate alignment and location of flashing, gravel stops, fascias and similar items.
3. Where tapered insulation is used, maintain insulation thickness at high points and roof edges shown on drawings.
    a. Low Point Thickness: Minimum 2 inches.
4. Use minimum two layers of insulation when required thickness is 68 mm (2.7 inch) or greater.

C. Lay insulating units with close joints, in regular courses and with end joints staggered.

1. Stagger joints between layers minimum 150 mm (6 inches).

D. Lay units with long dimension perpendicular to the rolled (longitudinal) direction of

the roofing felt.

E. Seal cut edges at penetrations and at edges against blocking with bitumen or roof cement.

F. Cut to fit tightly against blocking or penetrations.

G. Cover all insulation installed on the same day; comply with temporary protection requirements of Division 07 roofing section.

H. Installation Method:

1. Adhered Insulation:

a. Prime substrate as required.

b. Set each layer of insulation firmly in uniform application of full-spread insulation adhesive.

## 3.5 COVER BOARD INSTALLATION

A. Install cover boards over insulation with long joints in continuous straight lines with staggered end joints.

B. Offset cover board joints from insulation joints 150 mm (6 inches), minimum.

C. Secure cover boards according to "Adhered Insulation" requirements.

END OF SECTION

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SECTION 07 52 23
EPDM ROOFING

## PART 1 GENERAL

### 1.01 DESCRIPTION

A. The project consists of installing Adhered Roofing System as outlined below:

Apply the Adhered EPDM Roofing System in conjunction with 2" Rigid Polyisocyanurate over the new Pre-Cast Concrete roof deck.

### 1.02 EXTENT OF WORK

A. Provide all labor, material, tools, equipment, and supervision necessary to complete the installation of a 60-mil EPDM membrane Fully Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details.

B. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.

C. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.

D. Any contractor who intends to submit a bid using a roofing system other than the approved manufacturer must submit for pre-qualification in writing fourteen (14) days prior to the bid date. Any contractor who fails to submit all information as requested will be subject to rejection. Bids stating "as per plans and specs" will be unacceptable.

### 1.03 SUBMITTALS

A. Prior to starting work, the roofing contractor must submit the following:

1. Shop drawings showing layout, details of construction and identification of materials.

2. Sample of the manufacturer's Total Systems Warranty covering all components of the roofing system.

3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.

4. Certification of the manufacturer's warranty reserve.

B. Upon completion of the installed work, submit copies of the manufacturer's final inspection report to the specifier prior to the issuance of the manufacturer's warranty.

### 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.

B. Comply with the manufacturer's written instructions for proper material storage.

1. Store materials between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.

2. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.

C. Insulation and underlayment products must be on pallets, off the ground and tightly covered with waterproof materials. Manufacturer's wrap does not provide sufficient waterproofing. Insulation and underlayment products that become wet or saturated are to be discarded.

D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.05 WORK SEQUENCE

A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

B. Do not disrupt activities in occupied spaces.

1.06 USE OF THE PREMISES

A. Before beginning work, the roofing contractor must secure approval from the building owner's representative for the following:

1. Areas permitted for personnel parking.

2. Access to the site.

3. Areas permitted for storage of materials and debris.

4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.

1.07 EXISTING CONDITIONS

If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.08 PRE-CONSTRUCTION CONFERENCE

A. A pre-construction meeting will be held at the job site on.

B. Prior to start of construction, the roofing contractor should schedule a job site inspection to observe actual conditions and verify all dimensions on the roof. Access to the roof will be necessary before or after the pre-construction meeting

1.09 TEMPORARY FACILITIES AND CONTROLS

A. Temporary Utilities:

1. Water, power for construction purposes and lighting will be available at the site and will be made available to the roofing contractor.

2. Provide all hoses, valves and connections for water from source designated by the owner when made available.

3. When available, electrical power should be extended as required from the source. Provide all trailers, connections and fused disconnects.

B. Temporary Sanitary Facilities

Sanitary facilities will not be available at the job site.

C. Building Site:

1. The roofing contractor shall use reasonable care and responsibility to protect the building and site against damages. The contractor shall be responsible for the correction of any damage incurred as a result of the performance of the contract.

2. The roofing contractor shall remove all construction debris from the job site in a timely and legally acceptable manner so as to not detract from the aesthetics or the functions of the building.

D. Security:

Obey the owner's requirements for personnel identification, inspection and other security measures.

1.10 JOB SITE PROTECTION

A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide canvas, boards and sheet metal (properly secured) as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.

B. During the roofing contractor's performance of the work, the building owner will continue to occupy the existing building. The contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.

C. Do not overload any portion of the building, either by use of or placement of equipment, storage of debris, or storage of materials.

D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.

E. Store moisture susceptible materials above ground and protect with waterproof coverings.

F. Remove all traces of piled bulk materials and return the job site to its original condition upon completion of the work.

1.11 SAFETY

The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.12 WORKMANSHIP

A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.

B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.

C. There shall be a supervisor on the job site at all times while work is in progress.

D. All field seams and flashing details are to be completed according to manufacturer's specifications and details by the end of each work day.

1.13 QUALITY ASSURANCE

A. The Roofing System must achieve a UL Class A.

B. The specified roofing assembly must have been successfully tested by a qualified testing agency to resist the design uplift pressures calculated according to International Building Code (IBC) and American Society of Civil Engineers (ASCE 7) ANSI/SPRI WD-1 "Wind Design Standard Practice for Roofing Assemblies"

C. The membrane must be manufactured by the material supplier. Manufacturer's supplying membrane made by others are not acceptable.

D. The manufacturer must have a minimum of 20 years experience in the manufacturing of vulcanized thermoset sheeting.

E. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.

F. The roofing system must be installed by an applicator authorized and trained by the manufacturer

in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply EPDM roofing systems and having installed at least one (1) EPDM roofing application or several similar systems of equal or greater size within one year.

G. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.

H. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the specifier's consideration.

I. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to identify any needed corrective repairs that will be required for warranty issuance. Notify the Architect/Engineer seventy-two (72) hours prior to the manufacturer's final inspection.

J. Inspector shall be employed and trained by the manufacturer and have received product-specific training from the manufacturer of the products.

K. The Sure-Seal EPDM Membrane exceeds 41,580 $kJ/m^2$ under Xenon-Arc UV Light testing used for testing "Resistance to Outdoor (Ultraviolet) Weathering." (ASTM D 4637 Specification requires a 7560 $kJ/m^2$ minimum total radiant exposure at 70 $W/m^2$ irradiance at 176ºF black panel temperature to pass.)The membrane shows no visible signs of cracking or crazing.

L. Sure-Seal, Sure-White, or Sure-Tough EPDM Membranes achieves a zero (no growth) rating in the ASTM G21 test for fungi growth.

## 1.14 JOB CONDITIONS, CAUTIONS AND WARNINGS

Refer to Carlisle's EPDM Roofing System specification for General Job Site Considerations.

A. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.

B. When positioning membrane sheets, exercise care to locate all field splices away from low spots. All field splices should be shingled to prevent bucking of water.

C. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the Structural Engineer to prevent overloading and possible disturbance to the building structure.

D. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

E. Proceed with work so new roofing materials are not subject to construction traffic. When

necessary, new roof sections shall be protected and inspected upon completion for possible damage.

F. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

G. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

H. New roofing shall be complete and weathertight at the end of the work day.

I. Contaminants such as grease, fats and oils shall not be permitted to come in direct contact with the roofing membrane. An overlay of Epichlrohydrin membrane must be adhered around units which have the potential to emit solvents, grease or oil.

1.15 WARRANTY

A. Provide manufacturer's 20 year Total System Warranty covering both labor and all materials with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 90 mph measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.

B. Warranty shall also cover leaks caused by accidental punctures: 16 man-hours per year for 60-mil Sure-Tough reinforced membranes.

C. Warranty shall also cover leaks caused by hail:

1. Hail up to 1" diameter when 60-mil Sure-Seal or Sure-White OR 60-mil Sure-Tough is installed over Carlisle SecurShield HD, SecurShield HD FR, Dens Deck Prime, or Securock adhered with FAST or Flexible FAST adhesive (For Adhered Systems Only).

D. Pro-rated System Warranties shall not be accepted.

PART 2 PRODUCTS

2.01 GENERAL

A. Basis of Design: All components of the specified roofing system shall be products of Carlisle SynTec or by Firestone or Johnsmanville.

B. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

2.02 MEMBRANE

Furnish 60-mil EPDM (Ethylene, Propylene, Diene Terpolymer) in the largest sheet possible with 3" or 6" Factory-Applied Tape (FAT). The membrane shall conform to the minimum physical properties of ASTM D4637. When a 10 foot wide membrane is to be used, the membrane shall be manufactured in a single panel with no factory splices to reduce splice intersections.

2.03 INSULATION/UNDERLAYMENT

A. When applicable, insulation shall be installed in multiple layers. The first and second layer of insulation shall be mechanically fastened or adhered to the substrate in accordance with the manufacturer's published specifications.

B. Insulation shall be Polyisocyanurate as supplied by Carlisle SynTec. Minimum R-value required is Note R-10.

1. Carlisle SecurShield Polyisocyanurate– A foam core insulation board covered on both sides with a moisture resistant coated glass fiber mat facer meeting ASTM C 1289-06, Type II, Class 2, Grade 2 (20 psi) or Grade 3 (25 psi). The product is available in 4' x 8' standard size with a thickness of 2 inches.

2.04 FASTENING COMPONENTS

To be used for mechanical attachment of insulation and to provide additional membrane securement:

A. Insulation Adhesives

1. Flexible FAST Adhesive: An elongating impact resistant two component insulating urethane adhesive used to attach insulation. Packaging formats include 50 and 15 gallon drums.

a. Adhesive to provide 150% elongation in conjunction with fleece backed membrane – ASTM D412

b. MDI content of Part A material less than 25%

2.05 ADHESIVES, CLEANERS AND SEALANTS

All products shall be furnished by Carlisle and specifically formulated for the intended purpose.

A. 90-8-30A Bonding Adhesive: A high-strength, yellow colored, synthetic rubber adhesive used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces. Available in 5 gallon pails.

B. Low VOC Bonding Adhesive: A low VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces. This product meets the <250 gpl VOC (volatile organic compound) content requirements of the OTC Model Rule for Single Ply Roofing Adhesives. Available in 5 gallon pails.

C. Carlisle Weathered Membrane Cleaner: A clear, solvent-based cleaner used to loosen and remove dirt and other contaminants from the surface of exposed EPDM membrane (for repairs, etc.) prior to applying EPDM Primer. Weathered Membrane Cleaner can also be used when applying Splicing Cement. Available in 1 and 5-gallon pails.

D. Low-VOC EPDM Primer - A low VOC (volatile organic compound) primer (less than 250 grams/liter) for use with SecurTape or Pressure-Sensitive products. Available in 1 gallon pails.

E. Lap Sealant: A heavy-bodied material used to seal the exposed edges of a membrane splice. Available in tubes.

1. Sure-White Lap Sealant is a white sealant for use with Sure-White (white-on-black) Roofing

Systems.

F. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used to achieve a compression seal between the EPDM membrane or Elastoform Flashing and applicable substrates. Available in tubes.

G. One-Part Pourable Sealer: Available in black or white, a one-component, moisture curing, elastomeric polyether sealant used for attaching lightning rod bases and ground cable clips to the membrane surface and as a sealant around hard-to-flash penetrations such as clusters of pipes.

H. Universal Single-Ply Sealant A one-part polyether, non-sagging sealant designed for sealing expansion joints, control joints and counterflashings. Available in white only.

I. Cav-Grip Primer: a low VOC contact adhesive used to prime surfaces prior to the application of 725TR.

J. CAV-GRIP III Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: bonding Sure-Weld membrane to various surfaces, enhancing the bond between Carlisle's VapAir Seal 725TR and various substrates, priming unexposed asphalt prior to applying FAST Adhesive and for adhering Sure-Seal FleeceBACK and Sure-Seal EPDM membrane to vertical walls. Coverage rate is approximately 2,000 sq. ft. per cylinder as a primer, in a single-sided application and 1,000 sq. ft. per cylinder as an adhesive, in a double-sided application.

## 2.06 METAL EDGING AND MEMBRANE TERMINATIONS

A. General: All metal edgings shall be tested and meet ANSI/SPRI ES-1 standards and comply with International Building Code. All metal work is to be supplied and warranted by the manufacturer.

B. Drexel Metal Supplied or equal

1. SecurEdge 400: a coping or fascia, snap-on edge system consisting of a 22 gauge galvanized metal water dam and .040" thick aluminum, Kynar 500 finish or 24 gauge steel, Kynar 500 finish. Metal fascia color shall be as designated by the Owner's Representative. ANSI/SPRI ES-1 Certified.

2. SecurEdge 4000: a metal fascia system with a 20 gauge steel retainer bar and .040" thick aluminum, Kynar 500 or 24 gauge steel, Kynar 500 finish fascia. Metal fascia color shall be as designated by the Owner's Representative. ANSI/SPRI ES-1 Certified.

C. Hickman Supplied or equal

1. SecurEdge 300: a coping or fascia, snap-on edge system consisting of a 24 gauge galvanized metal, Kynar 500 finish. Metal fascia color shall be as designated by the Owner's Representative. ANSI/SPRI ES-1 Certified. Coping FM Approved 1-90 with 20 ga. Cleat, 1-180 with 16 ga. Cleat. Fascia FM Approved 1-225.

D. Drip Edge: a metal fascia/edge system with a 22 or 24 gauge continuous anchor cleat and .032 inch thick aluminum or 24 gauge steel fascia. Metal fascia color shall be as designated by the Owner's Representative.

E. SecurEdge Coping: incorporates a 20 gauge anchor cleat with 4 pre-slotted holes, a concealed joint

cover and 10 foot continuous sections of coping cap; can accommodate minimum 5 " wide parapet walls. Metal coping cap color shall be as designated by the Owner's Representative.

F. Termination Bar: a 1" wide and .098" thick extruded aluminum bar pre-punched 6" on center; incorporates a sealant ledge to support Lap Sealant and provide increased stability for membrane terminations.

G. SecurEdge Term Bar Fascia: A 1.75" wide formed aluminum termination bar with pre-slotted fastening holes for ease of locating and installing. The decorative cover is available in 0.040" aluminum or 24-gauge galvanized steel. SecurEdge Term Bar Fascia is manufactured in 12' lengths for fewer joints/seams, fewer sections to handle and faster installation.

2.07 WALKWAYS

Protective surfacing for roof traffic shall be Sure-White (white) Pressure-Sensitive Walkway Pads (with Factory-Applied Tape on the underside of the walkway) adhered to the membrane surface in conjunction with Sure-Seal Primer.

PART 3 EXECUTION

3.01 GENERAL

A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations and weather restrictions.

B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.02 INSULATION PLACEMENT

A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive Carlisle Flexible FAST Adhesive in accordance with the manufacturer's specifications.

3.03 MEMBRANE PLACEMENT AND BONDING

A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions and coverage rates, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.

C. Install adjoining membrane sheets in the same manner, overlapping edges approximately 4 inches. Do not apply bonding adhesive to the splice area.

3.04 MEMBRANE SPLICING

A. Position membrane sheet to allow for required splice overlap. Mark the bottom sheets with an indelible marker approximately 1/4" to 1/2" from the top sheet edge. The pre-marked line on the membrane edge can also be used as a guide for positioning splice tape.

B. When the membrane is contaminated with dirt, fold the top sheet back and clean the dry splice area (minimum 3" wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Sure-Seal Weathered Membrane Cleaner. When using Sure-Seal (black) PRE-KLEENED membrane, cleaning the splice area is not required unless contaminated with field dirt or other residue.

C. Apply EPDM Primer or Low VOC EPDM Primer to splice area and permit to flash off.

D. When adhering Factory Applied Tape (FAT), pull the poly backing from FAT beneath the top sheet and allow the top sheet to fall freely onto the exposed primed surface. Press top sheet on to the bottom sheet using firm even hand pressure across the splice towards the splice edge

E. For end laps, apply 3" or 6" SecurTAPE to the primed membrane surface in accordance with the manufacturer's specifications. Remove the poly backing and roll the top sheet onto the mating surface.

F. Tape splices must be a minimum of 2-1/2" wide using 3" wide SecurTAPE extending 1/8" minimum to 1/2" maximum beyond the splice edge. Field splices at roof drains must be located outside the drain sump.

Note: For projects where a 90-mil membrane OR 20-year or longer System Warranty is specified, splice enhancements are required. Refer to Carlisle Sure-Seal/Sure-White Roofing System Specificaiton.

G. Immediately roll the splice using positive pressure when using a 2" wide steel roller. Roll across the splice edge, not parallel to it. When FAT is used, Carlisle's Stand-Up Seam Roller can be used to roll parallel to the splice edge.

H. At all field splice intersections, apply Lap Sealant along the edge of the membrane splice to cover the exposed SecurTAPE 2" in each direction from the splice intersection. Install Carlisle's Pressure-Sensitive "T" Joint Covers or a 6" wide section (with rounded corners) of Sure-Seal Pressure-Sensitive Elastoform Flashing over the field splice intersection.

3.05 FLASHING

A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable. Use Pressure-Sensitive Curb Wrap when possible to flash curb units.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.06 WALKWAYS

A. Install walkways at all traffic concentration points (such as rooftop ladders, etc.) and all locations as identified on the specifier's drawing.

B. Adhere walkways pads or rubber pavers to the EPDM membrane in accordance with the manufacturer's specifications.

3.07 DAILY SEAL

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed.

3.08 CLEAN UP

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION

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SECTION 07 90 00
JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sealants and joint backing, precompressed foam sealers and accessories.

B. Related Sections:
   1. Section - Glazing: Glazing sealants and accessories.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C834 - Standard Specification for Latex Sealants.
   2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
   3. ASTM C1193 - Standard Guide for Use of Joint Sealants.
   4. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   5. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
   6. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

A. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

B. Samples: Submit two samples, 4” x 4” inch in size illustrating sealant colors for selection.

C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

D. Warranty: Include coverage for installed sealants and accessories failing to achieve watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALITY ASSURANCE

A. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience, and approved by manufacturer.

1.6 MOCKUP

A. Section 01 40 00 - Quality Requirements: Requirements for mockup.

B. Construct mockup of sealant joints in conjunction with window and wall mockups specified in other sections.

C. Construct mockup with specified sealant types and with other components noted.
   1. Determine preparation and priming requirements based on manufacturers recommendations; take action necessary for correction of failure of sealant tests on mock-up.
   2. Verify sealants, primers, and other components do not stain adjacent materials.

D. Locate where directed by Architect/Engineer.

E. Incorporate accepted mockup as part of Work.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

A. Manufacturers:
   1. For precast panels: Dow Corning, Pecora Chemical Co., Sonneborn Building Products.
   2. Substitutions: Section - Instructions to Bidders

B. Products Description:
   1. High Performance General Purpose Exterior (Nontraffic) Sealant: Silicone; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
      a. Type 1: As manufactured by Dow Corning.
      b. Color: Standard colors matching finished surfaces.
      c. Applications: Use for:
         1) Control, expansion, and soft joints in masonry and precast concrete panels.
         2) Joints between concrete and other materials.
         3) Joints between metal frames and other materials.
         4) Other exterior nontraffic joints for which no other sealant is indicated.

2. General Purpose Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T; multi- component.
    a. Type: Type 2: As manufactured by Dow Corning.
    b. Color: Standard colors matching finished surfaces.
    c. Applications: Use for exterior and interior pedestrian and vehicular traffic bearing joints.
3. Exterior Compressible Gasket Expansion Joint Sealer : ASTM D2628, hollow neoprene (polychloroprene) compression gasket.
    a. Type: Type 3: As manufactured by Dow Corning.
    b. Color: Black color.
    c. Size and Shape: As indicated on Drawings.
    d. Applications: Use for exterior wall expansion joints [and parking deck expansion joints].
4. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non-drying, non-skinning, non-curing.
    a. Type: Type 4: As manufactured by Dow Corning.
    b. Applications: Use for concealed sealant bead in sheet metal work.
5. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.
    a. Type: Type 5: As manufactured by Dow Corning.
    b. Color: Colors as selected.
    c. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.

## 2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: 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. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify substrate surfaces and joint openings are ready to receive work.

C. Verify joint backing and release tapes are compatible with sealant.

## 3.2 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this section from damage or disfiguration.

## 3.3 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Perform acoustical sealant application work in accordance with ASTM C919.

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.

I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

## 3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean adjacent soiled surfaces.

## 3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect sealants until cured.

## 3.6 SCHEDULE

A. Control and Expansion Joints in Paving: Type 2 and 3.

B. Joints Between Concrete Panels and Between Panels and Adjacent Work: Type 1.

C. Control, Expansion, and Soft Joints in Masonry, and Between Masonry and Adjacent Work: Type 1.

D. Lap Joints in Exterior Sheet Metal Work: Type 4.

E. Butt Joints in Exterior Metal Work: Type 4.

F. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type 5.

G. Under Exterior Door Thresholds: Type 5.

H. Interior Joints for Which No Other Sealant is Indicated: Type 5.

I. Control and Expansion Joints in Interior Concrete Slabs and Floors: Type 2 and 3.

J. Joints Between Plumbing Fixtures and Walls and Floors, and Between Counter tops and Walls: Type 5.

END OF SECTION

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SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

Section includes 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.

A. AWS American Welding Society
1. AWS D1. 1/D1.1M (2006) Errata 2006) Structural Welding Code Steel

B ASTM International

| | | |
|---|---|---|
| 1. | ASTM A 653 /A 653M | (2006) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| 2. | ASTM A 879/A 879M | (2006) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating on Each Surface. |
| 3 | ASTM A 924/A 924M | (2006) Standard Specifications for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| 4. | ASTM C 578 | (2006) Standard Specification for Rigid Cellular Polystyrene Thermal Insulation |
| 5. | ASTM C 591 | (2005) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation |
| 6. | ASTM C 612 | (2004) Mineral Fiber Block and Board Thermal Insulation |
| 7. | ASTM D 2863 | (2006a) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index) |

C. BHMA Builders Hardware Manufactures Association

| | | |
|---|---|---|
| 1. | BHMA A115 | (2006) ( Complete Set-Spec dates Vary)Specifications for Door and Frame Preparation for Hardware (Incl A115.1 (1990), A115.2 (1987) A115.4 (1994),A115.5 (1992), A115.12 (1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 ( 1994) |

D. NAAMM National Association of Architectural Metal Manufactures

| | | |
|---|---|---|
| 1. | NAAMM HMMA HMM | (1999; R 2000) Hollow Metal Manual |

E. SDI/DOOR Steel Doors Institute

| | | |
|---|---|---|
| 1. | SDI/DOOR 111 | (2000) Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories |
| 2. | SDI/DOOR 113 | (2001) Determining the Steady State Thermal Transmittance of Steel Door and Fame Assemblies |
| 3. | SDI/DOOR A250.11 | (2001) Recommended erection Instructions for Steel Frames |
| 4. | SDI/DOOR A 250.3 | (1999) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames |
| 5. | SDI/DOOR A250.4 | (2001) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing |
| 6. | SDI/DOOR A250.6 | (2003) Hardware on Steel Doors (Reinforcement – Application) |
| 7. | SDI/DOOR A250.8 | (2003) Recommended Specification for Standard Steel Doors and Frames |

1.2 SUBMITTALS

A. Shop Drawings: Show elevations, construction details, metal gauges, hardware provisions, method of glazing, and installation details.
   2. Doors
   3. Frames
   4. Accessories
   5. Weatherstripping

B. Product Data: Submit manufacturer's descriptive for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.
   1. Doors
   2. Frames
   3. Accessories
   4. Weatherstripping

1.3 DELIVERY, STORAGE AND HANDLING

B. Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 HOLLOW METAL DOORS

A. SDI/DOOR A250.8, Grade I, physical performance Level C. Door size(s), design(s), materials, construction gages and finish shall be as specified for standard steel doors and shall comply with the requirements of NAAMM HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 14 gage. Close tops of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08 71 00 - DOOR HARDWARE. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

## 2.2 INSULATED STEEL DOOR SYSTEMS

A. At the option of the Contractor, insulated steel doors and frames may be provided in lieu of Grade I standard steel doors and frames. Door size(s), design(s), and materials shall be as specified for standard steel doors. Insulated steel doors shall have a core of polyurethane foam and an R factor of 10.0 or more (based on a k value of 0.16); face sheets, edges, and frames of galvanized steel not lighter than 23 gauge, 16 gauge, and 16 gauge respectively; magnetic weatherstripping; non-removable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Doors and frames shall receive phosphate treatment, rust-inhibitive primer, and baked acrylic finish. Doors shall have been tested in accordance with SDI/DOOR A250.4 and shall have met the requirements for Level C. Prepare doors to receive specified hardware. Doors shall be 1-3/4 inch thick. Provide insulated steel doors and frames where shown.

## 2.3 ACCESSORIES

A. Astragals: For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 Door Hardware, provide overlapping steel astragals with the doors.

## 2.4 INSULATION CORES

A. Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI/DOOR 113 and shall conform to:
   1. Rigid Polyurethane Modified Polyisocyanurate Foam: ASTM C 591. Type I or II, foamed-in-place or in board form, with oxygen index of not less that 22 percent when tested in accordance with ASTM D 2863; or
   2. Rigid Polystyrene Foam Board; ASTM C 578, Type I or II; or
   3. Mineral board; ASM C 612, Type I.

## 2.5 STANDARD STEEL FRAMES

A. SDI/DOOR A250.8, Grade I, physical performance Level C. Form frames to sizes and shapes indicated, with welded corners.

B. Welded Frames: Continuously weld frame at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth. Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1 and in accordance with the practice specified by the producer of the metal being welded.

C. Anchors: Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter that 18 gauge.

D. Wall Anchors: Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

1. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped.

2. Complete openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111.

E. Floor Anchors: Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

## 2.6 WEATHERSTRIPPING

A. As specified in Section 08 71 00 Door Hardware.

B. Integral Gasket: Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb details specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283.

## 2.7 HARDWARE PREPARATION

A. Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the application requirements of SDI/DOOR A250.8 and SDI/Door A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

## 2.8 FINISHES

A. Factory Primed Finish: All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8. Where coating is removed by welding, apply touchup of factory primer.

B. Hot-Dip Zinc-Coated and Factory-Primed Finish: Fabricate scheduled doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot 122 grams per square meter,

total both sides; i.e., A40ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

C. Electrolytic Zinc-Coated Anchors and Accessories: Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 879/A 879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces specified in SDI/DOOR A250.8.

D. Factory-Applied Enamel Finish: Coatings shall meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of medium-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements shall be in accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as selected by Owner from samples provided by Contractor.

## 2.9 FABRICATION AND WORKMANSHIP

A. Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

B. Grouted Frames: For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Frames: Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat insides of frames with a corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

B. Doors: Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

C. Protection: Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire

brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

D. Cleaning: Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

END OF SECTION

SECTION 08 16 13

FIBERGLASS DOORS

PART 1 - GENERAL

1.1 CONDITIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.2 SECTION INCLUDES

A. Fiberglass doors.

B. Glass insert with snap-on frame no screws or plugs.

1.3 RELATED REQUIREMENTS

A. Section 08 12 00 - Metal Frames: Formed hollow metal frames for doors, and other openings.

B. Section 08 71 00 - Door Hardware.

C. Section 08 80 00 - Glazing.

1.4 REFERENCE STANDARDS

A. American Architectural Manufactures Association (AAMA):
   1. AAMA/WDMA/CSA 101/I.S.2/A440
   2. AAMA 1304 Forced Entry

B. ASTM International (ASTM):
   1. ASTM E283 - Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   2. ASTM E330 - Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
   3. ASTM E331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   4. ASTM E547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
   5. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission Class.

6. ASTM E1886 - Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
7. ASTM E1996 - Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

C. National Fenestration Rating Council (NFRC):
1. NFRC 100 - Procedure for Determining Fenestration Product U-Factors.
2. NFRC 200 - Procedure for Determining Fenestration Product Solar Gain Heat Coefficient and Visible Transmittance at Normal Incidence.
3. NFRC 400 - Procedure for Determining Air Infiltration.
4. NFRC 500 - Procedure for Determining Fenestration Product Condensation Resistance Values.

D. Underwriters Laboratories (UL):
1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

## 1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Submit for each type of door specified including details of core and edge construction and trim for openings.
1. Include factory finishing information.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in product data; and other pertinent data.

D. Test Reports: Submit for doors, indicating compliance with referenced standards.

E. Operation and Maintenance Data: For air doors to include in maintenance manuals.

F. Warranties: Sample of special warranties.

## 1.6 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of fiberglass doors of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide fiberglass doors produced by a manufacturer listed in this section.

B. Source Limitations: Obtain each type of fiberglass door through one (1) source from a single manufacturer.

## 1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of manufacturer's written instructions.

B. Package doors on pallets and protect with cardboard top and bottom, corner protectors, banding, and shrink wrap.

C. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

D. Protect from damage due to weather, excessive temperature, and construction operations.

## 1.8 WARRANTY

A. Warranty: Manufacturer's standard form, in which manufacturer warrants doors to be free of manufacturing defects in materials or workmanship.
   1. Warranty shall be in effect during the following period of time from date of Substantial Completion:
      a. Limited Lifetime.
   2. Glass Vision Panels: 10-year limited warranty.
   3. Factory Stained Finish: Five (5) year warranty.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: The design for fiberglass doors is based on products manufactured by Plastpro, Inc., 5200 W. Century Blvd, Ninth Floor, Los Angeles; CA 90045, Telephone: 310-693-8600; Fax: 310-693-8620; Website: www.plastproinc.com.

B. Substitutions: Possible manufacturers include ThermaTru, www.thermatru.com; Jeld-wen, www.jeld-wen.com; Pella, www.pella.com.

C. Substitutions will be considered under provisions of Section – Instructions to Bidders.

## 2.2 FIBERGLASS DOORS

A. Acceptable Products: Plastpro Trimmable Series.

B. Construction:
   1. Door Skins: High impact compression molded fiberglass reinforced material.
   2. Top and Bottom Rails: Composite material. Bottom rail accommodates a range of door sweeps.
   3. Stiles: Composite material; full-length of door.
   4. Extended Lockblock: Accommodates a minimum of 20 inches of lockblock.
   5. Core: 100 percent CFC-free polyurethane insulation.
   6. Hydroshield Technology™; water-resistant construction protects doors against water infiltration on all six (6) sides to prevent warping, delamination, corrosion, rotting, and build up of mold and mildew.
   7. 8'-0" Doors or Taller: Provide with a metal beam on the lock side of the door.

C. Acoustical Performance:
   1. Provide doors with a Sound Transmission Class (STC) rating calculated in accordance with ASTM E413 where indicated on Drawings as follows:
      a. Flush Opaque Doors: 22.
      b. Full Lite Doors with One (1) Inch Glass: 29.
   2. Provide doors with an Outdoor to Indoor Sound Transmission Class (OITC) rating calculated in accordance with ASTM E1332 where indicated on Drawings as follows:
      a. Flush Opaque Doors: 23.
      b. Full Lite Doors with One (1) inch Glass: 30.

D. Trimmable Doors:
   1. Smooth Skin.
   2. Construction similar to that described in Paragraph 2.2B with extended composite stiles and rails.
   3. Door Trimming: Construction of doors permits trimming up to one (1) inch from each composite stile, 1/2-inch from top rail and 1-1/2 inches from bottom rail.
   4. Glass Options: Insert glass type selected from manufacturer's currently available range of options.

E. Door Lites:
   1. Snap-on Doorlite Frames: Plastpro BTHP™ Snap-on Frames with specially designed clips to lock decorative glass firmly in place. Visible plugs or screws are unacceptable. Frames withstand temperatures over 200 degrees F.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine [frames and] substrates, for suitable conditions where fiberglass doors.

B. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

C. Reject doors with defects.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Hardware: Refer to Section 08 71 00 - Door Hardware for installation.

B. Install fiberglass doors in compliance with manufacturer's written instructions.

### 3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Factory Finished Doors: Replace doors that are damaged or do not comply with requirements. Repair or refinish doors if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

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SECTION 08 33 00
OVERHEAD COILING DOORS

PART 1-GENERAL

1.1 SUMMARY

A. The work of this Section includes steel rolling doors.

B. Related Sections: Other specification sections which directly relate to the work of this Section include, but are not limited to, the following:
1. Section 08 71 00 – Door Hardware

1.2 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's product data and installations for each type of rolling door; include both published data and any specific data prepared for this project.

C. Shop Drawings: Submit shop drawings for approval prior to fabrication. Include detailed plans and elevations; details of framing members; required clearances, anchors, and accessories. Include relationship with adjacent materials.

1.3 QUALITY ASSURANCE

A. Manufacturer: Rolling doors shall be manufactured by a firm with a minimum of five years experience in the fabrication and installation of coiling doors. Manufacturers proposed for use which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified, and include a list of five projects of similar design and complexity completed within the past five years.

B. Installer: Installation of rolling doors shall be performed by an authorized representative of the manufacturer.

C. Single-Source Responsibility: Provide doors, guides, and related primary components from one manufacturer for each type of door. Provide secondary components from source(s) acceptable to manufacturer of primary components.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide rolling doors by Overhead Door Corporation, Raynor or Wayne Dalton Corporation; or Engineer-approved equal.

## 2.2 ROLLING DOORS

A. Curtain: Interlocking roll-formed slats as specified following: End locks shall be attached to each end of alternate slats to prevent lateral movement.

B. Finish:
   1. Galvanized Steel: Slats and hood shall be galvanized steel in accordance with ASTM A 653 (2006 Ed.) and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked- on prime paint, and 0.6 mils thick baked-on polyester (powder coated) top coat. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.

C. Color: Gray polyester top coat. Powder coat finish in color selected by Owner from manufacturer's standard colors.

D. Windload Design: 20 PSF.

E. Weatherseals: Vinyl bottom seal, exterior guide and internal hood seals.

F. Bottom Bar: Two prime painted steel angles, minimum thickness 1/8" bolted back to back to reinforce curtain in the guides.

G. Guides: Three galvanized structural steel angles with minimum thickness of 3/1 6". Guides shall be weatherstripped with a vinyl weather seal at each jamb, on the exterior curtain side and interior curtain side.

H. Brackets: Hot-rolled galvanized steel to support counterbalance, curtain and hood.

I. Counterbalance: Helical torsion spring type designed for standard 20,000 cycle life design. Counterbalance shall be housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance shall be adjustable by means of an adjusting tension wheel.

J. Hood: Galvanized steel, hood with intermediate supports as required. Provide with internal hood baffle weatherseal.

K. Manual Operation: Chain-operated lifting and lowering. Consisting of endless steel chain, chain-pocket wheel and guard, and gear reduction unit with a maximum of 25 lb. f force for door operation. Provide alloy-steel hand chain with chan holder secure to operator guide.

L. Locking: Equip door with two slide bolts for padlock and chain lock keeper.

M. Vision Lites: None.

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

B. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

### 3.3 ADJUSTING AND CLEANING

A. Test coiling door for proper operation and adjust as necessary to provide proper operation without binding or distortion.

B. Touch-up damaged coatings and finishes and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

END OF SECTION

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SECTION 08 36 13
SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies manually and electrically operated sectional overhead steel doors.

1.2 RELATED WORK:

A. Overhead Roll-Up Doors: Section 08 33 00 - Overhead Coiling Doors.

B. Lock Cylinders for Cylindrical Locks: Section 08 71 00 - Door Hardware.

C. Field Painting of Factory Primed Doors: Section 09 90 00 - Painting.

D. Electrical Installation:
   1. Section - Requirements for Electrical Installations.
   2. Section - Requirements for Communications Installations.
   3. Section - Common Work Results for Electronic Safety And Security.

1.3 MANUFACTURER'S AND INSTALLER'S QUALIFICATIONS:

A. Manufacturer's with three (3) years' experience in providing items of type specified. Submit manufacturer qualifications.

B. Installers who are trained and approved by manufacturer for installation of units required. Submit installer qualifications.

1.4 SUBMITTALS:

A. Submit in accordance with Section - Shop Drawings, Product Data, and Samples.

B. Shop Drawings:
   1. Details of construction, accessories and hardware, electrical and mechanical items, supporting brackets for motors, location, and ratings of motors, and safety devices.
   2. Wiring diagrams for motors and controls, including wiring diagram for door, showing electrical interlock for motor with manually operated dead lock.

C. Manufacturer's Literature and Data:
   1. Brochures or catalog cuts.
   2. Manufacturer's installation procedures and instructions.
   3. Maintenance instructions, parts list.

D. Installer's qualifications.

E. Manufacturer's qualifications.

F. Certificates:
   1. Attesting door, anchors and hardware will withstand the horizontal loads specified.
   2. Attesting door complies with thermal performance, air infiltration, and water infiltration requirements.

G. Manufacturer warranty.

1.5 QUALITY ASSURANCE:

A. Source: Obtain sectional doors from single source from single manufacturer. Obtain operators and controls from sectional door manufacturer.

1.6 WARRANTY:

A. Manufacturer Warranty: Manufacturer shall warranty their sectional doors for a minimum of two

B. (2) years from the date of installation and final acceptance by the Government. Submit manufacturer warranty.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Architectural Manufacturers Association (AAMA):

2603-13 .....Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

C. American Society of Civil Engineers (ASCE):

7-10 .....Wind Load Provisions

D. ASTM International (ASTM):

A36/A36M-14.....Structural Steel

A227/A227M-06(R2011) .....Steel Wire, Cold-Drawn for Mechanical Springs

A229/229M-12.....Steel Wire, Oil-Tempered for Mechanical Springs

A653/A653M-12(R2013) .....Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy Coated (Galvanized) by the Hot Dip Process

C1036-11(R2012) .....Flat Glass

C1363-11 .....Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus

E84-14.....Surface Burning Characteristics of Building Materials

E283-04(R2012) .....Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Difference Across the Specimen

E330/E330M-14.....Structural Performance of Exterior Windows, Curtain Walls, and Doors by the Uniform Static Air Pressure Difference.

E331-00(R2009) .....Water Penetration of Exterior Windows, Curtain Walls, and Doors by the Uniform Static Air Pressure Difference.

E. American National Standards Institute and Door and Access Systems Manufacturers Association (ANSI/DASMA):

102-11 .....Sectional Overhead Type Doors.

F. National Electrical Manufacturer's Association (NEMA):

ICS 6-93(R2011).....Industrial Controls and Systems: Enclosures

MG 1-11(R2014) .....Motors and Generators

ST 20-14 .....Dry Type Transformers for General Applications

G. National Fire Protection Association (NFPA):

70-14 .....National Electrical Code

H. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06 .....Metal Finishes Manual

I. Underwriters Laboratories, Inc. (UL):

325-06(R2013).....Door, Drapery, Gate, Louver, and Window Operators and Systems

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Steel: ASTM A653/A653M for forming operations. ASTM A36/A36M for structural sections.

B. Hard Drawn Spring wire: ASTM A227/A227M.

C. Oil Tempered Spring wire: ASTM A229/A229M.

D. Glass: ASTM C1036
   1. Clear Glass: Type 1, Class 1, Quality q5, 6 mm (1/4 inch) thick.
   2. Fabricated into sealed insulating glass 25 mm (1 inch) thick.

E. Weather-strips, Gaskets, and Thermal Breaks:
   1. Neoprene, EPDM, PVC, silicone rubber, or other low conductance material.
   2. Standard with door manufacturer.

2.2 DESIGN REQUIREMENTS

A. Wind Load: Design to withstand uniform pressure (velocity pressure) of 960 Pa (20 lbs. per sq. ft.) acting inward and outward when tested in accordance with ASTM E330/E330M. Doors are to remain operable under design wind load.

B. Thermal Performance for Insulated Doors: Maximum U value of 0.14 for door when tested in accordance with ASTM C1363.

C. Air Infiltration for Exterior Doors: Maximum of 0.10 cfm at 24 Km (15 miles per hour) wind speed per foot of crack between door sections and door perimeter opening when tested in accordance with ASTM E283.

D. Water Infiltration for Exterior Doors: No infiltration when tested in accordance with ASTM E331.

E. Seismic Performance: Sectional doors are to withstand the effects of earthquake motions determined according to ASCE 7.

F. Comply with ANSI/DASMA 102. Provide metal doors with horizontal sections hinged together to operate in a system of tracks to completely close the door opening in the closed position and make the full width and height of the door opening available for use in the open position.

G. g. Operation-Cycle Requirements: Door components and actuators to operate for not less than 10,000 cycles.

2.3 FABRICATION

A. Steel Door Sections:
   1. Formed of hot-dipped galvanized steel.
   2. Meeting rails: Interlocking joints with thermal breaks separating face sheets formed to provide weathertight closure and alignment for full width of door.
   3. Height of Each Section: Not to exceed 610 mm (24 inches).
   4. Install glazing panels where indicated using rubber thermal break gaskets standard with door manufacturer.
   5. Provide foamed in place polycyanurate insulation with flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E84.
   6. Reinforced for hardware anchorage with not less than 10 gage galvanized steel.

B. Tracks:

1. Manufacturer's standard, formed of galvanized steel.
2. Track Configuration: High-lift track.
3. Minimum of 1.98 mm (14 gage) for 50 mm (2 inch) tracks and 2.78 mm (12 gauge) for 75 mm (3 inch) tracks.
4. Vertical tracks fabricated with adjustable brackets for mounting at incline to continuous steel angle wall bracket.
5. Horizontal Track: Reinforce with continuous steel angle anchored to vertical steel angle wall bracket and to ceiling angle supports. Provide vertical and cross or diagonal braces to obtain rigid installation of horizontal track.
6. Provide not less than 2.38 mm (13 gage) galvanized steel angles.

C. Hardware
1. Manufacturers standard hinges, brackets, rollers, locking devices and other hardware required for a complete installation.
2. Hinges and Roller Brackets: Minimum of 2.38 mm (13 gage) galvanized steel.
3. Provide rollers with ball bearings and case hardened races.
4. Provide positive locking device to receive cylinder lock, specified in Section 08 71 00, DOOR HARDWARE, with interlocking switch to motor actuator.
5. Weatherseals: Manufacturer's standard fitted around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.

D. Manual Operation:
1. Chain Hoist Operation: Provide galvanized, endless chain operating over a sprocket.
   a. Extend chain to within 1219 mm (4 feet) of the floor and mount on inside of building.
   b. Obtain reduction by use of roller chain and sprocket drive or gearing.
   c. Provide chain cleat and pin for securing actuator chain.
   d. Allow for installation of power actuators to chain hoist operator.
   e. Do not exceed the maximum lifting force of 111 newton (N) (25 pound force) required to operate the door.

## 2.4 ELECTRIC MOTOR OPERATIONS

A. Complete with electric motor, machine cut reduction gears, steel chain and sprockets, magnetic brake, overload protection, brackets, wall mount push button controls, limit switches, magnetic reversing contactor, and other accessories necessary for proper operation, including emergency manual actuator.

B. Design:
1. Design the actuator for motor removal without disturbing the limit-switch adjustment and without affecting the emergency manual actuators.
2. Make provision for emergency manual operation of door by chain-gear mechanism in case of electrical failure.
3. Arrange the emergency manual operating mechanism to immediately be put into and out of operation from the floor with a mechanical device to disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged. This operation is not to affect the adjustment of the limit switches.
4. Provide interlock with motor to prevent motor from operating when manual locks are activated.

C. Motors:
   1. NEMA MG 1, maximum operation 3600 rpm.
   2. Suitable for operation on power current of the characteristics indicated on the electrical construction documents.
   3. Use high starting torque, reversible type, of sufficient horsepower and torque output to move the door in either direction from door position, and produce door travel speed range of 0.20 to 0.30 m per second (8 to 12 inches per second), without exceeding the rated capacity.
   4. Single-phase motors are not to have commutation or more than one starting contact.
   5. Motor Enclosures: Drip proof type or NEMA TENV type.

D. Controls
   1. Control enclosures:
      a. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general- purpose NEMA ICS 6, Type 1 enclosure.
      b. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
   2. At door actuators, provide an enclosed, across-the-line type, magnetic reversing contactor, thermal overload protection, solenoid operated brake, limit switches, and remote control switches at locations on construction documents.
   3. Control switches:
      a. Three push button type on interior, unless noted to be key activated.
      b. Buttons marked, OPEN, CLOSE and STOP.
      c. The OPEN and STOP buttons: Momentary pressure or contact type.
      d. The CLOSE button: Constant pressure type.
      e. Provide key activated switch on exterior requiring constant pressure to operate.
      f. Limit switches: Manufacturers standard, position of switches readily adjustable.
   4. Operation
      a. Open door upon activation of OPEN button.
      b. Close door only when constant key pressure applied to CLOSE button.
      c. When the door is in motion, and the STOP button is pressed, door is to stop instantly and remain in the stop position; from stop position, door may be operated in either direction by OPEN or CLOSE button.
      d. Limit switches automatically stop doors at their fully open and closed positions.
   5. Provide push buttons with guards to prevent accidental operation.
   6. Transformer:
      a. Provide control transformer in power circuits to reduce the voltage on control circuits to 120 volts or less.
      b. Conform to NEMA ST 20.
   7. Electrical Components: Conform to NFPA 70.
   8. Safety Device:
      a. Provide bottom door edge weather-strip safety device to immediately stop and reverse the door closing to full open position upon contact with an obstruction in compliance with UL 325. Door is to open upon failure of device, component of device or component of control system.
      b. The door closing circuit is to be electrically locked out and door to remain capable of manual operation until the failure or damage has been corrected.
      c. Do not use safety device as a limit switch.

d. Safety Device Connecting Cable to Motor: Flexible type SO cable, with spring loaded automatic take up reel or equivalent device, as required for proper operation of the doors.

2.5 FINISHES

A. Steel:
1. Comply with NAAMM's AMP 500-06 Metal Finishes Manual for recommendations for applying and designating finishes.
2. Clean surfaces free of scale, rust, oil and grease.
3. Baked-Enamel or Powder-Coat Finish: AAMA 2603.
4. Galvanized steel: Apply phosphate treatment.
5. Apply shop prime coat of corrosion inhibitive paint on exposed surfaces after fabrication that is compatible with field applied finishes.
6. Apply finish paint of color scheduled when specified in Section - Schedule for Finishes.
7. Do not paint track, rollers, hinges, or locks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with approved shop drawings and manufacturer's instructions.

B. For electrical work, see:
1. Section - Requirements for Electrical Installations.
2. Section - Requirements for Communications Installations.
3. Section - Common Work Results for Electronic Safety And Security.

C. Locate anchors and inserts For tracks, brackets, motors, switches, hardware, and other accessories in accordance with approved shop drawings.

D. Attach tracks to adjoining construction with not less than 9 mm (3/8 inch) diameter bolts, spaced near each end and not over 610 mm (24 inches) apart.

E. Locate control switches where indicated in construction documents, not less than 1219 mm (4 feet) or more than 1372 mm (4 feet 6 inches) above finished floor.

F. Lubricate, adjust and demonstrate door to operate freely.

G. Upon completion, leave door openings weathertight and doors free from warp, twists, or distortion.

3.2 REPAIR:

A. Repair zinc-coated surfaces both bare and painted, by the application of galvanizing repair compound.

B. Spot prime and apply finish paint to repairs.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. The work of this Section includes door handles, locks, hinges, strikes, closers and other door hardware.

B. Related Sections: Other specification sections directly related to the work of this Section include the following:
1. Section – Hollow Metal Doors and Frames
2. Section – Overhead Coiling Doors

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basis designation only.

A. ASTM International (ASTM)

| | | |
|---|---|---|
| 1. | ASTM E 283 | (2004) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure |
| 2. | ASTM F 883 | (2004) Padlocks |

B. Builders Hardware Manufacturers Association (BHMA)

| | | |
|---|---|---|
| 1. | BHMA A156.1 | (2006) Butts and Hinges |
| 2. | BHMA A156.12 | (2005) Interconnected Locks & Latches |
| 3. | BHMA A156.13 | (2005) Mortise Locks & Latches, Series 1000 |
| 4. | BHMA A156.15 | (2006) Closer Holder Release Devices |
| 5. | BHMA A156.16 | (2002) Auxiliary Hardware |
| 6. | BHMA A156.17 | (2004) Self Closing Hinges & Pivots |
| 7. | BHMA A156.18 | (2006) Materials and Finishes |
| 8. | BHMA A156.2 | (2003) Bored and Preassembled Locks, Latches |
| 9. | BHMA A156.21 | (2006) Thresholds |
| 10. | BHMA A156.22 | (2005) Door Gasketing and Edge Seal Systems |
| 11. | BHMA A156.3 | (2001) Exit Devices |
| 12. | BHMA A156.4 | (2000) Door Controls – Closers |
| 13. | BHMA A156.5 | (2001) Auxiliary Locks & Associated Products |
| 14. | BHMA A156.6 | (2005) Architectural Door Trim |
| 15. | BHMA A156.7 | (2003) Template Hinge Dimensions |
| 16. | BHMA A156.8 | (2005) Door Controls - Overhead Stops and Holders |
| 17. | BHMA 630 | Satin Stainless Steel |

C. Steel Door Intuition (SDI/DOOR)

| | | |
|---|---|---|
| 1. | SDI/DOOR A250.8 | (2003) Recommended Specification for Standard Steel Doors and Frames |

D. Underwriters Laboratories (UL)

| | | |
|---|---|---|
| 1. | UL Bld Mat Dir | (2006) Building Materials Directory |
| 2. | UL 305 | Panic Hardware |

1.3 SUBMITTALS

A. Submit the following in accordance with Section - Submittal Procedures.
   1. Shop Drawings:
      a. Hardware schedule.
      b. Keying system.
   2. Product Data:
      a. Hardware items.
   3 Manufacturer's Instructions:
      a. Installation.
   4. Closeout Submittals:
      a. Key bitting. Provide a listing of all keys (AA-1, AA-2, etc.); a floor plan showing doors and door numbers; and a tabulation showing which keys fit which doors.

1.4 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within warranty period.
   1. Warranty Period for Manual Closers: 10 years from date of Substantial Completion. Closer body shall carry a life of the building warranty.

1.5 QUALITY ASSURANCE

A. Hardware Manufacturers and Modifications: Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Deliver permanent keys and removable cores to the Owner, either directly or by certified mail.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

A. Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

## 2.2 HARDWARE FOR EXIT DOORS

A. Provide all hardware necessary to meet the requirements of NFPA 101 for exit doors, as well as to meet other requirements indicated, even if such hardware is not specifically mentioned.

## 2.3 HARDWARE ITEMS

A. Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

1. Hinges: BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be non-removable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.
   Number of Hinges:
   a. Butt Hinges: Two hinges for every door up to 60". One additional hinge for every additional 30" of door height.
2. Spring Hinges: BHMA A156.17.
3. Locks and Latches:
   a. Mortise locks and latches: BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inch with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Install knobs and roses of mortise locks with screwless shanks and no exposed screws.
   b. Bored locks and latches: BHMA A156.2 Series 4000, Grade 1.
4. Exit Devices: BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms. Provide escutcheons, not less than 7 by 2-1/4 inch.
   a. Panic Exit Devices: Shall be listed and labeled for panic protection, based on testing according to UL 305.
   b. All latch bolts shall be deadlocking.
   c. All exposed metal shall be in BHMA 630. Aluminum base metal products will not be accepted.
   d. Outside operating trim shall be through-bolted with concealed fasteners.
   e. Operating trim shall be freewheeling with clutch mechanism allowing lever to rotate 60 degrees when locked to prevent vandalism.
5. Cylinders and Cores: Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with six pin tumblers. Provide cylinders from products of manufacturer Medeco, and provide cores from the products of Medeco.
6. Keying System: Provide an extension of the existing keying system and do not have interchangeable cores.
7. Lock Trim:
   a. Cast, forged, or heavy wrought construction and commercial plain design.
   b. Knobs and Roses: Conform to the minimum test requirements of BHMA A156.2 and BHMA A156.13 for knobs, roses, and escutcheons.

For unreinforced knobs, roses, and escutcheons, provide 0.050 inch thickness. For reinforced knobs, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch, except for knob shanks, which are 0.060 inch thick.

8. Keys: Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group.
   a. All locks at Booster Pump Station No. 1 shall be keyed- alike, including the disinfectant building. Exception taken for the overhead door.
   b. All locks at Booster Pump Station No. 1 shall be keyed- alike, including the disinfectant building. Exception taken for the overhead door.
9. Door Bolts: BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.
10. Closers:
    a. BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, pivots, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty
    b. Identification Marking Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.
11. Overhead Holders: BHMA A156.8.
12. Closer Holder-Release Devices: BHMA A156.15.
13. Door Stops and Silencers: BHMA A156.16 Silencers Type L03011. Provide three silencers for each single door, two for each pair.
14. Padlocks: ASTM F 883.
15. Thresholds: BHMA A156.21. Use J35100, with vinyl or silicone rubber insert in face of stop, for exterior doors opening out, unless specified otherwise.
16. Weather Stripping Gasketing: BHMA A156.22. Provide a set to include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Provide weather-stripping with one of the following:
    a. Extruded aluminum retainers. Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.
    b. Interlocking type: Zinc or bronze not less than 0.018 inch thick.
    c. Spring tension type: Spring bronze or stainless steel not less than 0.008 inch thick.
17. Gasketing: BHMA A156.22. Include adjustable doorstops at head and jambs and an automatic door bottom per set, both of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Provide doorstops with solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Furnish door bottoms with adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops mitered at corners.
18. Rain Drips: Extruded aluminum, not less than 0.08 inch thick, clear anodized. Set drips in sealant and fasten with stainless steel screws.

a. Door rain drips: Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door
b. Overhead rain drips: Approximately 1-1/2 inch high by 2-1/2 inch projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

19. Special Tools: Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

## 2.4 FASTENERS

A. Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

## 2.5 FINISHES

A. BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except prime coat finish for surface door closers, and except BHMA 600 finish (primed for painting) for steel hinges. Provide hinges for exterior doors in stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Furnish exit devices in BHMA 626 finish. Match exposed parts of concealed closers to lock and door trim.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install hardware in accordance with manufacturers' printed installation instructions. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

1. Weather Stripping Installation: Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.
   a. Stop applied weather stripping: Fasten in place with color-matched sheet metal screws not more than 9 inches on center after doors and frames have been finish painted.
   b. Interlocking types of weather stripping: Provide interlocking, self-adjusting type on heads and jambs and flexible hook type at sills.

2. Threshold Installation: Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

## 3.2 EXIT DOORS

A. Install hardware in accordance with NFPA 101 for exit doors.

## 3.3 HARDWARE LOCATION

A. SDI/DOOR A250.8, unless indicated or specified otherwise.

## 3.4 FIELD QUALITY CONTROL

A. After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Engineer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Engineer. As directed, correct, repair, and finish errors in cutting and fitting and damage to adjoining work.

## 3.5 DOOR HARDWARE SETS FOR PRIMARY DOORS IN BOOSTER PUMP STATION BUILDINGS:

A. 3 hinges

B. 1 exit device

C. 1 IC core cylinder

D. 1 pull

E. 1 closer

F. 1 threshold

G. 1 weather strip set

END OF SECTION

SECTION 08 91 26
DOOR LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Louvers for doors, including:
   a. Frames;
   b. louvers, and;
   c. fasteners.

B. Related Requirements:
1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Section - Submittal Procedures: For administrative and procedural requirements for processing of submittals during the construction phase.
3. Section - Closeout Procedures: For administrative and procedural requirements for completion of the Work.
4. Section - Doors and Frames: For door types to receive louvers.
5. Section - Painting: For field painting of door louvers.

1.2 REFERENCES

A. Reference Standards:
1. ASTM International (ASTM):
   a. ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   b. ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
   c. ASTM A879/A879M-12, Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
   d. ASTM A1008/A1008M-12a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
   e. ASTM F2329-11, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

2. International Code Council (ICC):
   a. North Carolina Building Code; 2018 Edition

1.4 ACTION SUBMITTALS

A. Submit in accordance with Section - Submittals:
1. Product Data:
   a. Materials description for door louvers including details showing mounting type, frame type, materials, and construction.

b. Installation instructions for each product specified.

2. Shop Drawings:
   a. Include details of each frame type, elevation of frame and louver, anchorage and accessory items.
   b. Schedule showing each type of door louver, locations, sizes, and other data pertinent to installation
   c. Indicate installation procedures and accessories required for a complete installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle door louvers using means and methods that will prevent damage, deterioration, or loss.
   1. Deliver units in manufacturer's original packaging, properly labeled for identification.

PART 2 - PRODUCTS

2.1 DOOR LOUVER MANUFACTURERS

A. Acceptable Manufacturers:
Air Louvers, Inc., a division of Activar Construction Products Group
9702 Newton Ave S, Bloomington, MN 55431, www.activarcpg.com

B. Substitutions: Manufacturers seeking approval of their products are required to comply with the Owner's Instructions to Bidders, generally contained in the Project Manual.

2.2 PERFORMANCE REQUIREMENTS

A. Free Air Flow Area:

1. Model 800A1: 50 percent.

2.3 800 SERIES - INVERTED Y-BLADE LOUVER

A. Inverted Y-Blade Louver Assembly, Model No. 800A1: Inverted Y-Blade louver with 1-inch (25.40-mm) blade spacing resulting in a non-vision or sight-restrictive view, attached to 1-inch (25.40 mm) deep welded frame, by interlocking construction, and subsequently mounted in a surrounding frame.
   1. Louver and Frame Material: 20-gauge steel blades and 18-gauge cold-rolled steel (CRS) frame.
   2. Surrounding Frame: 2-piece frame 1-1/4 inches (31.75 mm) high with corners mitered and welded, and with pre-punched mounting holes on the security side of frame.
   3. Louver and Frame Finish: Factory-applied powder coat finish.
      a. Color Options: To be selected from manufacturers' full range.
   4. Frame Size: Refer to sizes shown on the Door Schedule.
   5. Fasteners: Flathead Phillips drive SMS, #8 by 3/4 inch (19.05 mm); finish to match frames.
   6. Options:

a. Louver and Frame Material: Galvannealed (J)
b. Fasteners: Torx security fasteners.
c. Screens:
1) Insect Screen: 18 by 14 mesh aluminum screen material in roll-formed aluminum frame.
2) Bird Screen: 1/4 inch or 1/2 inch (6.35 mm or 12.70 mm) galvanized steel mesh in roll-formed aluminum frame.
3) Fasteners: Sheet metal screws.

B. Louver Operation:
1. Manual Operation: Adjustable louver blades pivot on cadmium-plated steel rivets, and are operated by a manual adjusting lever.

2.7 MATERIALS

A. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, cold rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

2.8 FABRICATION

A. General: Furnish each louver and frame assembly manufactured as an integral unit, complete and ready for installation.
B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes.
C. Frames: Grind exposed welds smooth and flush with adjacent surfaces.
1. Provide mounting holes in frames for attachment of units to doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for installing door louvers.
B. Install door louvers in door openings to result in finished assembly which meets the applicable fire rating of doors, if any.

3.3 ADJUSTING AND CLEANING

A. Remove louver frames that are warped, bowed, or otherwise damaged, and replace with new components.
B. On completion of door louver installation, clean exposed surfaces as recommended by manufacturer.

END OF SECTION

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SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

**PART 1** GENERAL

1.1 RELATED SECTIONS

1. Section - Submittal Procedures
2. Section – Construction/Demolition Waste Management and Disposal.
3. Section - Blanket Insulation

1.2 REFERENCES

1. American Society for Testing and Materials, (ASTM)
    1. ASTM C475, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
    2. ASTM C514, Specification for Nails for the Application of Gypsum Board.
    3. ASTM C840, Specification for Application and Finishing of Gypsum Board.
    4. ASTM C954, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
    5. ASTM C1002, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
    6. ASTM C1047, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
    7. ASTM C1280, Standard Specification for Application of Gypsum Sheathing.
    8. ASTM C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
    9. ASTM C1396/C1396M, Standard Specification for Gypsum Wallboard.
2. Association of the Wall and Ceilings Industries International (AWCI)
    1. AWCI Levels of Gypsum Board Finish.

1.3 SUBMITTALS

1. Submit 300 mm size samples of corner and casing beads insulating strip.

1.4 DELIVERY, STORAGE AND HANDLING

1. Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

2. Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

3. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 SITE ENVIRONMENTAL REQUIREMENTS

1. Maintain temperature minimum 10° C, maximum 21° C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

2. Apply board and joint treatment to dry, frost free surfaces.

3. Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

1.6 QUALIFICATIONS

1. Dry wall installers: minimum 5 years proven experience.

## **PART 2** PRODUCTS

2.1 MATERIALS

1. Standard board: to ASTM C1396/C1396M regular and Type X, thicknesses as indicated on drawings, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

2. Glass mat water-resistant gypsum board: to ASTM C1178/C1178M with glass mat facings, both sides, regular and Type X, thicknesses as indicated on drawings, 1200 mm wide x maximum practical length, ends square cut, long edges tapered.

3. Metal furring runners, hangers, tie wires, inserts, anchors: to CSA A82.30 galvanized.

4. Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

5. Resilient drywall furring: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

6. Steel drill screws: to ASTM C1002.

7. Casing beads, corner beads, control joints and edge trim: to ASTM C1047, metal, zinc-coated by hot-dip process 0.5 mm base thickness, perforated flanges, one piece length per location.

8. Sealants: in accordance with Section - Joint Sealing.

9. Acoustic sealant: to CGSB 19-GP-21M.

10. Polyethylene: to CAN/CGSB-51.34, Type 2.

11. Insulating strip: rubberized, moisture resistant, 3 mm thick cork strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.

12. Joint compound: to ASTM C475, asbestos-free.

2.2 FINISHES

1. Texture finish: asbestos-free standard white texture coating and primer-sealer, recommended by gypsum board manufacturer.

## **PART 3** EXECUTION

3.1 ERECTION

1. Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

2. Do application of gypsum sheathing to ASTM C1280.

3. Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.

4. Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

5. Install work level to tolerance of 1:1200.

6. Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles, and other protrusions.

7. Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

8. Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

9. Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

10. Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.

11. Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

12. Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.2 APPLICATION

1. Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.

2. Apply single/double layer gypsum board to wood or metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm oc.

    1. Single-Layer Application:
        1. Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.
        2. Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

3. Apply water-resistant gypsum board where wall tiles are to be applied and adjacent to slop sinks janitors' closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

4. Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

5. Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

6. Install gypsum board on walls vertically to avoid end-butt joints.

7. Install gypsum board with face side out.

8. Do not install damaged or damp boards.

9. Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

1. Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm oc using contact adhesive for full length.

2. Install casing beads around perimeter of suspended ceilings.

3. Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

4. Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

5. Construct control joints of two back-to-back casing beads set in gypsum board facing and supported independently on both sides of joint.

6. Provide continuous polyethylene dust barrier behind and across control joints.

7. Locate control joints at changes in substrate construction.

8. Install control joints straight and true.

9. Install access doors to electrical and mechanical fixtures specified in respective sections.

    1. Rigidly secure frames to furring or framing systems.

10. Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

11. Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:

    1. Levels of finish:
        1. Level 2: Embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.(For use where water resistant gypsum backing board is used as a substrate for tile.)
        2. Level 4: Embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.

12. Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

13. Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

14. Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

15. Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

16. Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

17. Mix joint compound slightly thinner than for joint taping.

18. Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

19. Allow skim coat to dry completely.

20. Remove ridges by light sanding or wiping with damp cloth.

21. Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 09 90 00
PAINTING

PART l GENERAL

1.1 RELATED DOCUMENTS:

The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK:

The extent of painting work is shown on the drawings and schedules, and as herein specified.

The work includes painting and finishing of interior and exterior exposed items and surfaces throughout the project, except as herein specified.

> Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections, except as otherwise specified.

The work includes field painting of all bare and covered pipes and ducts, and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under the mechanical and electrical work, except in Mechanical Rooms.

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

Paint all exposed surfaces whether or not colors are designated in "schedules", except where the natural finish of the material is obviously intended and specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If color or finish is not designated, the Architect will select these from standard colors available for the materials systems as specified.

1.3 PAINTING NOT INCLUDED:

The following categories of work are not included as part of the painter-applied finish work, unless otherwise shown or specified.

Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, and similar items. Also, for fabricated components such as architectural woodwork, wood casework, and shop-fabricated or factory-built mechanical and electrical equipment or accessories.

Pre-finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, acoustic materials, architectural woodwork and casework, wood and synthetic athletic flooring products, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets.

Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, and duct shafts.

Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and

similar finished materials will not require finish painting, except as otherwise indicated.

Operating Parts and Labels: Do not paint any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, unless otherwise indicated.

Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.4 SUBMITTALS:

Manufacturer's Data; Painting: For information only, submit 2 copies of manufacturer's specifications, including paint label analysis and application instructions for each material specified. Indicate by transmittal that a copy of each manufacturer's instructions has been distributed to the Paint Applicator.

Samples; Painting: Submit samples for Architect's review of color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Provide a listing of the material and application for each coat of each finish sample.

On 12" x 12" hardboard, provide 2 samples of each color and material, with texture to simulate actual conditions. Resubmit each sample as requested until required sheen, color and texture is achieved.

On concrete masonry, provide two 4" square samples of masonry for each type of finish and color, defining filler, prime and finish coats.

1.5 DELIVERY AND STORAGE:

Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label.

Provide labels on each container with the following information:

Name or title of material.
Fed. Spec. number, if applicable.
Manufacturer's stock number.
Manufacturer's name.
Contents by volume, for major pigment and vehicle constituents.
Thinning instructions.
Application instructions.

1.6 JOB CONDITIONS:

Do not apply water-base paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 50 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 PRODUCTS

2.1 COLORS AND FINISHES:

Paint surface treatments and finishes are shown on the drawings and indicated in the Schedule included at the end of this Section.

Prior to beginning work the Architect will furnish sample color chips for surfaces to be painted. Match the colors of the chips and submit samples, as specified herein, before proceeding with the work.

Proprietary names used to designate colors or materials are not intended to imply that products of the manufacturers are required to the exclusion of equivalent products of other manufacturers.

Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coating system for various substrates. Upon request from other trades furnish information on characteristics of specified finish materials, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.2 MATERIAL QUALITY:

Provide the best quality grade of the various types of coatings as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

Provide undercoat paint produced by the same manufacturer as the finish coats. Use only thinners approved by the paint manufacturer, and use only within recommended limits.

Paint materials shall be from one of the following manufacturers or approved equal:

Benjamin Moore
Sherwin-Williams Company

Materials: See "schedule" following this section for material types required.

PART 3 EXECUTION:

3.1 INSPECTION:

Applicator must examine the areas and conditions under which painting work is to be applied. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.

Starting of painting work will be construed as the Applicator's acceptance of the surfaces and conditions within any particular area.

Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

## 3.2 SURFACE PREPARATION:

General: Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces.

Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, and cement plaster to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, then correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

Clean concrete floor surfaces scheduled to be painted with a 5% solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid and allow to dry before painting.

Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with the same type shop primer.

Galvanized metal to be painted shall be thoroughly washed with a solution of · pintBlue Vitrol, 2 oz. 30% Muriatic Acid in one gallon of water, or other approved solution, then thoroughly washed with clean water. Metal shall be dry before paint is applied.

Dents, cracks, hollow places, open joints and other irregularities in metal work to be painted shall be filled with an approved metal filler suitable for the purpose, which after setting, shall be sanded to a smooth, hard finish.

## 3.3 MATERIALS PREPARATION:

Mix and prepare painting materials in accordance with manufacturer's directions.

Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before

using.

3.4 APPLICATION:

General: Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.

Apply additional coats when undercoats or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.

Paint the back sides of access panels, and removable or hinged covers to match the exposed surfaces.

Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.

Sand lightly between each succeeding enamel or varnish coat.

On structural steel metal surfaces which have been shop-primed, sand to bear metal any rusted areas and spot prime with Devoe Coatings 4160-XXXX Tank and Structural Primer. On other metal surfaces which have been shop-factory primed, e.g., hollow metal door frames, sand to bear metal any rusted areas and spot prime with Devoe Coatings 4160-XXXX Tank and Structural Rust Inhibitive Primer.

Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, to provide a total dry film thickness of not less than 5.0 mils for the entire coating system of prime and finish coats for 3-coat work.

Prime Coats: Apply a prime coat to material which is required to be painted or finished, and which have been prime coated by others.

Recoat primed and sealed walls where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no-burn-through or other defects due to insufficient sealing.

Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture.

Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.

Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

Provide satin finish for final coats, unless otherwise indicated.

Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.5 CLEAN-UP AND PROTECTION:

Clean-Up: During the progress of the work, remove from the project daily all discarded paint materials, rubbish, cans and rags.

Upon completion of painting work, clean all window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

Protection: Protect other work against damage by painting and finishing work. Correct any damages by cleaning, repairing or replacing, and repainting, as directed by the Architect.

Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3.6 PAINTING AND FINISHING SCHEDULE:

Plans, schedules, and details on the drawings indicted the extent of work to be performed. The Architect shall select colors from the manufacturer's full color line available for the product furnished.

Provide the scheduled paint systems for the various substrates indicated. The schedule is general in nature, therefore, some of the listed substrates and/or areas listed may not be incorporated in the work of this project.

Except as noted otherwise on the drawings or in these specifications, furnish products equal and similar to Sherwin Williams products denoted in the following schedule:

**INTERIOR PAINTING SCHEDULE**

| | |
|---|---|
| **SUBSTRATE MATERIAL** | CONCRETE MASONRY UNITS (CMU) |

| | |
|---|---|
| **ITEM** | A |
| *Building Element and/or Location* | WALLS: TYPICAL ROOMS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | BLOCK FILLER | | | *Number of Coats* | 1 |
| *Paint Type* | ACRYLIC | *MPI Category* | 4 | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B42W46 | | *Gloss Description* | FLAT | |
| *Product Name* | HEAVY DUTY BLOCK FILLER | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | ACRYLIC | *MPI Category* | 52 | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 3 |
| *Catalog Number* | B20W2600 SERIES | | *Gloss Description* | EGGSHELL | |
| *Product Name* | PROMAR 200 ZERO VOC EG-SHEL | | | | |

| **ITEM** | C |
|---|---|
| *Building Element and/or Location* | WALLS: TOILETS, CLOSETS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | BASE COAT / FILLER | | | *Number of Coats* | 1 |
| *Paint Type* | SYNTHETIC | *MPI Category* | 4 | *VOC Category* | |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B42W46 | | *Gloss Description* | FLAT | |
| *Product Name* | HEAVY DUTY BLOCK FILLER | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE EPOXY POLYAMIDE | *MPI Category* | | *VOC Category* | 1 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | |
| *Catalog Number* | B73W111 | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | WATERBASED TILE CLAD EPOXY COATING | | | | |

| **SUBSTRATE MATERIAL** | GYPSUM BOARD PRODUCTS |
|---|---|

| **ITEM** | A |
|---|---|
| *Building Element and/or Location* | WALLS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | LATEX | *MPI Category* | 50 | *VOC Category* | 1 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | |
| *Catalog Number* | B28W2600 | | *Gloss Description* | FLAT | |
| *Product Name* | PROMAR 200 ZERO VOC INTERIOR LATEX PRIMER | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | ACRYLIC | *MPI Category* | 52 | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 3 |

| | | | |
|---|---|---|---|
| *Catalog Number* | B20W2600 SERIES | *Gloss Description* | EGGSHELL |
| *Product Name* | PROMAR 200 ZERO VOC EG-SHEL | | |

| | |
|---|---|
| **ITEM** | B |
| *Building Element and/or Location* | WALLS: KITCHENS, TOILETS, JANITOR/CUSTODIAL CLOSETS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | LATEX | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B51W620 | | *Gloss Description* | FLAT | |
| *Product Name* | PROBLOCK INTERIOR EXTERIOR LATEX PRIMER | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE EPOXY POLYANIDE | *MPI Category* | | *VOC Category* | |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | |
| *Catalog Number* | B73W111 | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | WATERBASED TILE CLAD EPOXY COATING | | | | |

| | |
|---|---|
| **SUBSTRATE MATERIAL** | FERROUS METAL |

| | |
|---|---|
| **ITEM** | A |
| *Building Element and/or Location* | BEAMS, COLUMNS, LINTELS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE | *MPI Category* | 107 | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B66W1 | | *Gloss Description* | FLAT | |
| *Product Name* | DTM ACRYLIC PRIMER/FINISH | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE ACRYLIC | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B66W650 SERIES | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | PRO INDUSTRIAL ACRYLIC SEMI-GLOSS COATING | | | | |

| **ITEM** | C |
|---|---|
| *Building Element and/or Location* | DOORS AND FRAMES |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE | *MPI Category* | 107 | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B66W1 | | *Gloss Description* | FLAT | |
| *Product Name* | DTM ACRYLIC PRIMER/FINISH | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE ACRYLIC | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B66W650 SERIES | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | PRO INDUSTRIAL ACRYLIC SEMI-GLOSS COATING | | | | |

| **SUBSTRATE MATERIAL** | FERROUS METAL (GALVANIZED) |
|---|---|

| **ITEM** | A |
|---|---|
| *Building Element and/or Location* | DOORS AND FRAMES |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE | *MPI Category* | 107 | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |

| | | | |
|---|---|---|---|
| *Catalog Number* | B66W1 | *Gloss Description* | FLATE |
| *Product Name* | DTM ACRYLIC PRIMER/FINISH | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE ACRYLIC | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B66W650 SERIES | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | PRO INDUSTRIAL ACRYLIC SEMI-GLOSS | | | | |

**EXTERIOR PAINTING SCHEDULE**

| | |
|---|---|
| **SUBSTRATE MATERIAL** | FERROUS METAL (NON-GALVANIZED) |

| | |
|---|---|
| **ITEM** | A |
| *Building Element and/or Location* | BEAMS, COLUMNS, LINTELS |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE | *MPI Category* | 107 | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B66W1 | | *Gloss Description* | FLAT | |
| *Product Name* | DTM ACRYLIC PRIMER/FINISH | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE ACRYLIC | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B66W650 SERIES | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | PRO INDUSTRIAL ACRYLIC SEMI-GLOSS | | | | |

| **ITEM** | B |
|---|---|

| *Building Element and/or Location* | DOORS AND FRAMES |
|---|---|

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIMER | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE | *MPI Category* | 107 | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B66W1 | | *Gloss Description* | FLAT | |
| *Product Name* | DTM ACRYLIC PRIMER/FINISH | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE ACRYLIC | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B66W650 SERIES | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | PRO INDUSTRIAL ACRYLIC SEMI-GLOSS | | | | |

| **ITEM** | C |
|---|---|

| *Building Element and/or Location* | GUARDRAILS AND HANDRAILS |
|---|---|

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | PRIME | | | *Number of Coats* | 1 |
| *Paint Type* | WATERBORNE EPOXY POLYAMIDE | *MPI Category* | | *VOC Category* | 3 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | N/A |
| *Catalog Number* | B73A200 | | *Gloss Description* | N/A | |
| *Product Name* | WATERBASED TILE CLAD EPOXY PRIMER | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Coat/Layer* | INTERMEDIATE AND TOP COAT | | | *Number of Coats* | ONE EACH |
| *Paint Type* | WATERBORNE EPOXY POLYAMIDE | *MPI Category* | | *VOC Category* | 2 |
| *Manufacturer* | SHERWIN-WILLIAMS | | | *Gloss Level* | 5 |
| *Catalog Number* | B73W111 | | *Gloss Description* | SEMI-GLOSS | |
| *Product Name* | WATERBASED TILE CLAD EPOXY COATING | | | | |

3.7 CONTRACTORS PAINT SCHEDULE:

Prior to beginning any painting operation, submit to the Architect for review and for the Owner's Maintenance records, four copies of a complete painting schedule which includes actual products proposed for use on this project. Schedule shall be similar to the schedule included within these specifications and shall completely identify each product by name, catalog number, etc. Identify fillers, primers, finish coats, etc.

In addition to this schedule, submit complete manufacturer's product description including recommended usage and compatible products for each material proposed for this project.

END OF SECTION

SECTION 09 95 55
EPOXY WALL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies epoxy wall coatings.

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section - Waste Management and Disposal

B. Section - Sealants

C. Section - Painting

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Division 01 for requirements pertaining to product options and substitutions.

1.4 REFERENCE DOCUMENTS

A. American Society for Testing and Materials (ASTM)
   1. ASTM D522-93a(2008) - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
   2. ASTM D1308-02(2007)- Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
   3. ASTM D2486-06 -Standard Test Methods for Scrub Resistance of Wall Paints
   4. ASTM E96/E96M-05 Standard Test Methods for Water Vapor Transmission of Materials

1.5 QUALIFICATIONS

A. The work of this Section shall be applied only by products. experienced applicators of the specified

1.6 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's printed product literature, specifications and data sheets in accordance with Section - Submittal Procedures.
   2. Submit three copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section - Submittal Procedures. Indicate VOCs during application and curing.

B. Samples
   1. Submit 300 mm x 300 mm representative sample of wall coating in selected color. Identify sample by project name including material and color identification.

2. Site apply sample installation to minimum 3 feet square area, to surface as directed, for approval by the Province. Retain approved sample until work is completed and accepted.

## 1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Installers / Applicators / Erectors:
      a. The work of this Section shall be applied only by experienced applicators of the specified products.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Deliver materials undamaged, in original containers, with manufacturer's labels and seals intact.

B. Storage and Handling Requirements:
   1. Store materials in protected conditions with a minimum temperature of 12°C.

C. Waste Management and Disposal:
   1. Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Management and Disposal.

## 1.9 SITE CONDITIONS

A. Ambient Conditions
   1. For exterior coatings: Comply with coating manufacturer's recommendations. Do not apply under adverse weather conditions which could affect coating performance.
   2. For interior coatings: Minimum surface temperature 10°C 24 hours before, during and 24 hours after application or until cured; adequate controlled ventilation; bright, uniform lighting; broom clean; reasonably dust free.

## 1.10 PROTECTION

A. Protect adjacent surfaces from damage and overspray resulting from work of this Section. Mask or cover adjacent surfaces. Make good any damage at own expense, to the Province's satisfaction.

B. Post "Wet Coatings" and "No Smoking" signs while work is in progress and curing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Solvent based, two component thermo-setting, 100% epoxy coating meeting the following requirements:

| Property | Test Method | Requirement |
|---|---|---|
| Water vapor transmission | ASTM E96 | 0.3 metric perms. max. |
| Color fastness | CGSB 1-GP-71 Fade-ometer | No color change, chalking or film defects, after 48 hours |
| Fire resistance | ASTM D1360 Cabinet method | Less than 17 g lost over masonry backing |
| Scrubbability | ASTM D2486 Gardner Scrubbability Machine | No effect on film after 5000 cycles |
| Radiation resistance | Exposure to Gamma rays of 35 roentgen intensity per hour at distance of 1625 mm from Cobalt 60 cell | Unaffected as measured by difference in reflectance |
| Toxicity | Evaluated by Canadian Department of Agriculture | Approved non-toxic |

2.1 MATERIALS (Cont'd)

| Property | Test Method | Requirement |
|---|---|---|
| Heat & cold cycling | 50 cycles on masonry backing. Each cycle 8 hours at 70°C 16 hours at 23°C | No cracking, loss of adhesion, or other film defects |
| Flexibility | ASTM D522 Mandrel Test | Passing 3 mm bend without cracking or peeling |
| Impact resistance | CGSB 1-GP-71, Method 147.1 Gardner Impact Test | Passing 11 J without cracking |
| Stain resistance | ASTM D1308 | Not affected by common acids, hydroxides, salts and household cleaning agents |

2.2 COLORS

A. One color will be selected by the Owner from manufacturer's standard range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all surface conditions to which the work of this Section is to be applied. Reports any deficient surfaces to the Province.

3.2 PREPARATION/APPLICATION

A. Prepare surfaces and apply in accordance with manufacturer's instruction.

B. Match finished work to approved samples, maintain uniform thickness, sheen, color, texture and free from defects detrimental to appearance or performance.

C. Minimum cured thickness of applied material shall be 200 to 250 micrometres.

3.3 CLEANUP

A. Promptly, as the work proceeds and upon completion, clean up excess materials and rubbish.

3.4 APPLICATION SCHEDULE

| Room No./Name | Finish | Color |
|---|---|---|
| Toilet | Semi-Gloss | TBD |

END OF SECTION

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SECTION 10 28 13
TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Toilet and bath accessories.

1.2 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet Accessory Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 01. Provide lists of replacement parts and service recommendations.

1.3 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet Accessory Schedule.
   1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
   2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
   1. Minimum Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
   1. Toilet Accessories:
      a. A & J Washroom Accessories, Inc.
      b. American Specialties, Inc.
      c. Bobrick Washroom Equipment, Inc.
      d. Bradley Corporation.
      e. GAMCO; div. of Bobrick Washroom Equipment Inc.
      f. McKinney/Parker Washroom Accessories Corp.
      g. Columbia Accessories.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Toilet Accessory Schedule at the end of Part 3.

### 2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 1008/A 1008M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. Mirror Glass: ASTM C 1503, mirror glazing quality, clear-glass mirrors, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

G. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

### 2.3 FABRICATION

A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

### 3.3 TOILET ACCESSORY SCHEDULE

A. Toilet and Bath Accessories: Catalog numbers given are Bradley unless otherwise noted:

1. TTD Toilet tissue dispensers: Surface-mounted, controlled, double roll # R5000TBK by San Jamar.
2. SD Soap dispensers: Liquid, surface-mounted horizontal-tank # 6542.
3. GB Grab bars: Concealed mounting, stainless-steel: length indicated: 800-series.
4. EHD Electric Hand Dryer: surface mounted #XL-BW Xlerator Hand Dryer by Xcel Dryer, Inc.
5. SND Sanitary napkin disposal units: Surface-mounted # 4791-15.
6. SNV Sanitary napkin vendor units: surface mounted #4017-11.

END OF SECTION

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DIVISION 26 — ELECTRICAL SPECIFICATION INDEX

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SECTION 26 0100 - GENERAL PROVISIONS - ELECTRICAL

PART 1 – GENERAL

DESCRIPTION OF WORK:

The work covered by Division 26 of these specifications consists of furnishing all labor, equipment, supplies, and materials, and performing all operations, including trenching, backfilling, cutting, channeling, chasing and patching necessary for the installation of complete wiring systems in accordance with the contract documents.

The Contract Drawings indicate the extent and general arrangement of the electrical work. The drawings and specifications shall be considered supplementary, one to the other, so that materials and workmanship indicated, called for or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. All labor and material required to perform all work in conjunction therewith whether or not indicated or specified shall be furnished and installed as part of this work.

Instruction to Bidders and General Conditions of the Contract, Supplementary Instructions to Bidders, Guidelines for Recruitment and Selection of Minority Business, and Division 1 General Requirements are part of Division 26 - Electrical.

The electrical subcontractor may also be referred to in this specification as "electrical contractor", "this contactor", "contactor", "Contractor", "Division 26 contractor", "subcontractor", or "Division 26 subcontractor".

DRAWINGS AND SPECIFICATIONS:

It is understood that while drawings shall be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear in the Contract Documents will be clarified if application is made to the Architect in accordance with the General Conditions and Supplements thereto. However, should conditions arise where, in the judgment of the Contractor, certain changes will be advisable, the Contractor shall communicate with the Architect and secure his review of these changes before proceeding with the work, provided they are of a major nature.

The drawings are diagrammatic and are not intended to show each and every conductor, fitting, device, conduit, or a complete detail of all the work to be performed, but are for the purpose of illustrating the type system and special conditions necessary for the experienced electrician to take off his material and lay out his work. The Contractor shall be responsible for making such measurements as may be necessary at the Project and adapting his work to the project conditions.

Drawings shall not be scaled. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule or architectural drawings for material, finish and construction method of walls, floor and ceiling in order to insure proper rough-in and installation of work.

APPLICABLE SPECIFICATIONS AND STANDARDS:

The following specifications and standards, along with the provisions of the North Carolina Construction manual, as applicable to the materials and methods specified, shall be considered part of these specifications:

AEIC American Association of Edison Illuminating Companies
ANSI American National Standards Institute
ASHRAE/IES 90.1 Code
ASTM American Society for Testing and Materials
ETL Electric Testing Laboratories
NCSBC The North Carolina State Building Code
ICEA Insulated Cable Engineers Association
IEEE Institute of Electrical and Electronic Engineers
NEC National Electrical Code, 2014
NEMA National Electrical Manufacturers Association
NESC National Electrical Safety Code
UL Underwriters' Laboratories Inc.
OSHA Occupational Safety and Health Standards

All referenced manufacturer's requirements and specifications and nationally recognized and accepted standards and specifications shall be the latest edition unless specified otherwise and shall be used as they are applicable for products and craftsmanship incorporated in the Contract Drawings and this Section only. The references to these standards and specifications do not imply acceptance of any and all products described in the standards and specifications.

APPLICABLE REGULATIONS:

The installation shall comply with the applicable rules of the National Electrical code and rules and regulations of the NCSBC. In no case shall the materials and workmanship fail to meet the minimum requirements of the 2014 National Electrical Code. All electrical work shall be inspected by the Owners Electrical Personnel and shall comply with all Owners Installation Standards.

SUBMITTALS:

All submittals shall be reviewed, corrected as necessary prior to submitting to Architect/Engineer and stamped "Approved" by the contractor.

Materials List:

As soon as practicable and in accordance with the General Conditions of the Contract, and before commencement of installation of any materials or equipment, submit six copies of a complete schedule of the materials and equipment proposed for installation and of names of specialty subcontractors for approval by the Architect/Engineer.

The schedule shall, as soon as possible, be supplemented by catalog cuts, diagrams, lighting fixture brochures, shop drawings, field working drawings and such descriptive data as may be required by the Architect/Engineer. In the event any items of materials or equipment contained in the schedule fail to comply with the specification requirements, such items will be rejected.

Where shop drawings are called for in other sections of the specifications, the list shall name the manufacturer and item and state "Shop Drawings to Follow."

The Architect/Engineer shall be notified immediately - in writing, of delivery scheduling of the material not ordered for immediate shipment. The first payment estimate will not be approved until the Architect/Engineer is satisfied that all material is ordered and delivery scheduled so that there will be no delay to the job because of getting material. The contractor may be required to remove and replace at his own expense any material installed before approval.

Shop Drawings:

Shop drawings shall be submitted conforming to the requirements stated in Division 26 and General Requirements and in the supplementary general conditions for the following items:

. Panelboards (catalog cuts)
. Lighting Fixtures (catalog cuts)
. Wiring Devices (catalog cuts)
. Disconnect Switches
. Special Electrical Systems
. Additional items as specified in technical sections.

Installation Instruction:

Submit to the Architect/Engineer manufacturer's installation, operation and maintenance instructions for all electrical protective or operable equipment immediately after the completion of the job.

Operation and Maintenance Manuals:

See General Conditions and Supplements thereto. The contractor shall compile and bind 3 sets of all operation and maintenance manuals, equipment and parts lists, instructions, and descriptive literature furnished by the manufacturers of the furnished equipment to assist in the proper maintenance and operation of equipment. These instructions shall be turned over to the architect with application for final payment, and final payment will not be made until received. Each brochure shall include 1 copy of each of all approved shop drawings, catalog pages, instruction sheets, operating instructions, installation and maintenance instructions, and spare parts bulletins.

EQUIPMENT SIZES:

Listing of a manufacturer as a source of acceptable equipment does not relieve the contractor and the manufacturer of this equipment from the requirement of meeting all aspects of the contract documents including that of having to fit the equipment in the space allocated.

GUARANTEE:

The electrical contractor shall guarantee by his acceptance of this contract that all work installed will be free from any and all defects in workmanship and/or materials and that all apparatus will develop capacities and characteristics specified. Refer to General Conditions of the Contract.

GENERAL PROVISIONS - ELECTRICAL SECTION 26 01 00
Supplemental General Conditions for guarantee period. Additional guarantee requirements are specified in other sections of this specification.

SITE INSPECTION:

Each electrical bidder shall visit the site of the work and familiarize himself with the character and conditions of the job site. The Contractor shall not be excused from doing required work because he did not visit the site.

RECORD DRAWINGS:

At the end of the project, the Contractor shall submit one set of the electrical drawings updated to reflect changes that have taken place during the construction period for use by the Architect/Engineer for his preparation of record drawings. The corrected plans shall indicate all changes and deviations from the original contract documents. The Contractor shall maintain during construction a current and accurate set of construction documents marked with the changes that may have taken place during the course of the project. The use of the field coordination drawings as record drawings is not acceptable.

TEMPORARY FACILITIES:
Temporary facilities shall be provided as required, as specified.

ABBREVIATIONS:

The following abbreviations may be found in this specification and in the drawings in addition to the ones listed under Applicable Specifications and Standards paragraph.

A Ampere
AC Alternating Current
*A/E* Architect/Engineer
ADA Americans with Disabilities Act
AEIC Association of Edison Illuminating Companies
AHJ Building Code Authority Having Jurisdiction
ANSI American National Standards Institutes, Inc.
ASTM American Society for Testing and Materials
ASYMM Asymmetrical
AWG American Wire Gauge
C Conduit
CBM Certified Ballast Manufacturers
CFM Cubic Feet per Minute
DB Decibel
DC Direct Current
EMT Electric Metallic Tubing
ETL Electric Testing Laboratories
F Fuse or Fahrenheit, as applicable
GFI Ground Fault Interrupter
HZ Hertz
IBC/NC N.C. International Building Code 2000/NCSBC 2002
IEEE Institute of Electrical and Electronic Engineers
IMC Intermediate Metal Conduit
KV Kilovolt (1000-volt)
KVA Kilovolt Ampere

MA Milliampere
MCM Thousand Circular Mil or KCMi1
NCDoI North Carolina Department of insurance
NCSBC North Carolina State Building Code
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
NOC Normally Open Contact
NCC Normally Closed Contact
PVC Polyvinyl Chloride
RMC or GRC Rigid Metal Conduit, Schedule 40
RMS Root Mean Square
RNMC Rigid Non-Metallic Conduit
RS Rapid Start
SYMM Symmetrical
UL Underwriters' Laboratories, Inc.

PART 2 - PRODUCTS:

MATERIALS:

All materials used in this work shall be new unless otherwise noted. All materials used on this project shall be listed and labeled by one of the third party agencies which have been approved by the North Carolina Building Code Council, where they have established a standard for the material to be installed, Any material installed that is not labeled shall be subject to a field evaluation by one of these approved agencies, at the contractor's expense, if authorized by the authority having jurisdiction and the Architect/Engineer. Otherwise, any item not approved by the agency shall be replaced by the contractor at his expense. It shall be the contractor's responsibility to verify that materials specified or used on the project are labeled. Materials are all items other than labor that are part of the electrical contract, including, but not limited to, devices, appliances and equipment.

Catalog numbers and trade names in these specifications and noted on the drawings are intended to describe the class of the material, devices or apparatus wanted and not to limit competition.

Where "or equivalent as accepted by the Architect/Engineer" is specifically noted in the specifications, reference to any article, device, product, material, fixture, or type of construction by name, make or catalog number, such reference shall be interpreted only as establishing a standard of quality and shall not be construed as limited competition. The Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the A/E expressed in writing is acceptable as equivalent to that specified.

The contractor shall immediately upon request present samples and test data from a recognized independent testing laboratory of the proposed substitute items so that the A/E judgment may be based upon comparison of actual items rather than just catalog cuts.

The A/E may request that the Contractor provide full sized model of the proposed material or assembly, at a location convenient to the A/E for a complete evaluation. All presentations shall be made by the Contractor's representative and not by the representative of the manufacturer of the equipment.

Materials from listed manufacturers shall only be acceptable if they can properly fit in the allocated spaces without interference from building walls, ceilings, piping conduit, ducts or other equipment.

The contractor, through the manufacturer of the equipment specified here, shall review the use, details, and methods of installation of his product as indicated and shall disclose to the A/E any and all deviations from his recommended use and method of installation and shall also disclose to the A/E his recommendations for the use and method of installation of his product to achieve the intended purpose and result. Such disclosure shall be made within the time stipulated for submission of shop drawings.

EXTENDED WARRANTIES:

The following products shall have warranties in excess of one-year:

Section 26 0925 — Occupancy Sensors: 5-Year Warranty, where applicable.
Section 26 5000 — Building Luminaries: 5-Year Warranty on Fluorescent Electronic Ballasts and LED Fixtures, where applicable.

PART 3 - EXECUTION:

PHASING AND SEQUENCING OF WORK:

Work under Division 26 - Electrical shall be phased and scheduled to all other trades approved schedule of work as dictated by the General Contractor and Owner.

DIMENSIONS:

Electrical equipment, fixtures and plans are not to be scaled. Necessary dimensions shall be obtained from architectural and structural drawings. Verify, as required, by field measurements all dimensions and plans shown on drawings.

INSPECTIONS:

The electrical contractor is responsible to coordinate owner inspections with the owner. Verify with the owner all items that are required for inspection by them prior to beginning any work. The electrical contractor shall be responsible for notifying the local AHJ to schedule all required electrical inspections including the final inspection.

WORK OBSERVATIONS:

Contractor shall cooperate with architect/engineer during the performing of project observations and project punch lists during the construction and post-construction (warranty) periods. Open and close equipment doors and equipment cover, as required to gain access to equipment for observation by the architect/engineer as many times as requested. Provide qualified electricians to assist architect/engineer during observations and while performing punch listings.

COORDINATION OF WORK:

Installation of electrical conduits, boxes and equipment shall not interfere with access to other equipment, its controls or its maintenance. Electrical contractor shall verify with other trades, prior to installation of electrical equipment so that the electrical work will not interfere with any required access to these other contractors.

The Contractor shall coordinate the work under his contract as to avoid conflicts between his work and the work of other trades. Contractor shall carefully examine the drawings prior to running any conduit and shall be responsible for the proper fittings of materials and equipment into the space provided prior to installing any conduit or equipment in accordance with requirements of the National Electrical Code. If any departures from the contract drawings are deemed necessary by the Contractor, detail drawings of such departures and the reasons therefore shall be submitted *as* soon *as* practicable to the Architect/Engineer for his review. No such departures shall be made without this review and written clarification or change order.

Relocation of equipment, system connections or rough-in locations up to twenty feet, if necessary, and as required by conditions identified on the field coordination drawings, shall be done at no additional cost to the Owner or his agents if identified before roughing-in.

Electrical Contractor shall cooperate with other contractors and subcontractors to allow for the installation of their work *as* well as his own.

The Electrical Contractor shall be responsible for his work fitting in place without conflict with the other trades, where proper planning could avoid interference. Any work installed by this Contractor without regards for the work of others, or if a conflict results, must be changed as directed by the Architect/Engineer without additional cost to the Owner.

Coordinate with other trades to assure that no pipe or duct is run above panelboard or switchboard, prior to the installation of this equipment. Inform Architect/Engineer of any case where there is conflict.

The contractor shall verify that the electrical equipment to be installed fits in the assigned space prior to running any conduit or installing the equipment. Any potential conflict shall be brought to the attention of the A/E at once.

The Architect/Engineer reserves the right of observing all concealed work, before being covered. This Contractor shall notify the Architect/Engineer of the need of a job observation at least two working days prior to concealment of work.

Do not install outlets back-to-back, regardless of what may appear to be shown on drawings. Outlets installed on opposite sides of same wall shall be installed not less than 12" apart as viewed on plan and 24" apart if wall is fire rated, unless suitable fireproofing protection is provided, as specified in Section 26 0541.

SUPERVISION:

The contractor shall have in charge of the work at all times during construction, a thoroughly competent foreman with extensive experience in the work to be performed under this contract. Anyone deemed not capable by the Architect/Engineer shall be replaced immediately upon request, and after a satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Engineer.

CUTTING AND PATCHING:

This Contractor shall do all cutting, patching, finishing, painting and core-drilling necessary for the proper installation of conduit, boxes and cabinets and shall repair any damage done by himself or his workmen. All conduit shall be run concealed in new and existing walls and ceilings except that exposed conduit is acceptable in equipment rooms, storage rooms and unfinished spaces that do not have ceilings.

WASTE MATERIALS:

The Contractor shall at all times keep the premises free from accumulation of waste materials or rubbish caused by his employees or work. At the completion of the work he shall remove all leftover materials, equipment and debris resulting from the work done under this Division.

Waste that is classified by law, state or Federal agencies as hazardous or toxic, like fluorescent lamps, ballasts, or other equipment containing PCB's, shall be discarded through bonded hazardous waste disposal facilities utilizing methods prescribed by law.

ACCESS TO EQUIPMENT:

All equipment shall be installed in location and manner that will allow for convenient access for maintenance and inspection. Adjust location shown on drawings for placement of electrical equipment to assure that the required NEC clearances are maintained.

Access doors and panels in walls and ceilings shall be provided as required for concealed equipment, controls and boxes, and all other items under Division 26 requiring accessibility for operation and maintenance. Doors and panels shall be provided conforming to Section 26 05 41 under Division 26 -Electrical.

INTERRUPTION OF ELECTRICAL UTILITIES:

The operation of the plants must be maintained at all times. ANY interruption in service shall be clarified with and approved by the owner prior to shut down.

CONTINUATION OF ELECTRICAL SERVICES:

It is imperative that all utilities and services be maintained at all times except for approved scheduled interruptions. Should emergency repairs be required to systems that exist within construction limits, the Contractor shall cooperate with the Owner to insure that these services are restored as soon as possible. The intent is to maintain full operation by providing temporary power, generator power or both to maintain operation at all times. The electrical contractor shall provide all provisions, both permanent and temporary, to maintain operation as required by the owner.

FIRE PROOFING:

It is the responsibility of this contractor to provide all additional fire proofing required to maintain the fire resistance integrity and rating of floors, walls and ceilings that may be compromised by the installation of conduits, raceways, boxes and electrical cabinets.

END OF SECTION 26 0100

SECTION 26 01 11 - ELECTRICAL OUTLINE OF WORK

PART 1 - GENERAL

GENERAL:

The work included in Division 26 electrical includes, but is not necessarily limited to the following items and systems:

- Complete demolition of existing electrical on site as indicated or required.
- Temporary electrical as indicated or required to maintain full operation of the plant during the entire construction phase.
- New panelboards
- Branch circuits, including conduits, outlets, boxes, receptacles, switches, and fittings.
- Wiring devices
- Lighting fixtures
- Safety switches
- Power supply to all equipment requiring power

END OF SECTION 26 01 11

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SECTION 26 01 34 Electrical Connections

PART 1 -GENERAL

Equipment Connections:

Control Wiring: Control wiring for equipment not provided under Division 26– Electrical, unless specifically called for on the electrical drawings will be provided by the respective equipment contractor.

PART 2- PRODUCTS

Disconnect Switches:

. Disconnect Switches shall be NEMA 4X Heavy Duty, quick make, quick break, with visible blades, voltage rating, number of poles and amperage as indicated on the drawings unless indicated otherwise.

PART 3- EXECUTION

RACEWAY CONNECTIONS:

Equipment connections shall be made through raceway as previously specified except that connections to motor and appliances shall be through liquid tight flexible metal conduit with grounding conductor, as applicable. Flexible conduit connections shall be as specified in Section 26 0531.

COORDINATION:

It shall be the responsibility of the Electrical Contractor to verify adequacy of supply wiring, over current protection, proper voltage, phase rotation, maximum temperature rating of branch circuit conductor, and final location of the equipment provided by the Owner and under other sections of these specifications prior to the running of any conduit or wiring. Report to the Architect/Engineer any discrepancy or mismatch between equipment being connected and incoming branch circuit or feeder.

END OF SECTION 26 0134

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SECTION 26 02 35 - ELECTRICAL TESTING

PART 1 - GENERAL

SCOPE OF WORK:

Provide testing of electrical wiring and systems as specified here.

WORK SPECIFIED ELSEWHERE:

Additional testing is required for special systems and special equipment as specified in other sections.

DOCUMENTATION:

All test equipment shall have been recently calibrated or within 6 months of testing date. Calibration Sheets shall be provided and indicated date calibrated.

All tests for conductors #1/0 and larger shall be witnessed by Owner Electrical Personnel.

All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.

All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the pre-requisites for final acceptance of the project.

PART 3 - EXECUTION

600 VOLTS WIRING FEEDER INSULATION RESISTANCE TESTING:

All current carrying phase conductors and neutrals shall be tested as installed, before connections are made, for insulation resistance and accidental grounds. This shall be done with a megger. The procedures listed below shall be as follows:

. Minimum reading shall be for 500 volts and one million (1,000,000) or more ohms for conductors below #1/0 AWG in size.

. Minimum reading shall be for 1KV and, 250 Mega-ohms or more for #1/0 AWG wire or larger, between conductors and between conductor and the grounding conductor.

.All conductors of a multi-phase circuit shall be replaced if one conductor fails. If a part of a multi-set circuit fails, then only the set that had the failure shall be replaced.

. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure at each panelboard. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are obtained. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

. The contractor shall submit to the A/E certified feeder insulation test results 10 days prior to energizing feeder. The test certifications shall identify the feeder, when the test was accomplished, the name of the electrician that conducted the test and the name of the person responsible for the test, test values and signature of person responsible for the test.

GROUND SYSTEM TESTING:

Refer to Section 26 0526 and 26 0527.

ELECTRICAL LOAD BALANCE TESTS AND SYSTEMS CONTINUITY TESTS:

With all the loads connected to the power system, verify that load is suitably balanced among the three phases of the power distribution system and that the system circuits are free of interruptions, faults, and accidental grounding.

OTHER TESTS

Refer to other technical specs for other required tests not listed here.

COMMISSIONING:

This contractor, and the manufacturer of the equipment and materials specified in this section, shall provide the labor, materials, equipment, services and support required by the project commissioning agent to accomplish the successful commissioning of the equipment and systems specified here.

END OF SECTION 26 0235

SECTION 26 05 19 **-** BUILDING WIRE AND CABLE

PART 1 - GENERAL

SCOPE OF WORK:

This Section applies to secondary power and signaling conductors for systems rated 600 volts and below.

A complete system of conductors shall be installed in the raceway systems as specified here and shown on drawings.

RELATED WORK SPECIFIED ELSEWHERE:

APPLICABLE SPECIFICATIONS AND STANDARDS:

Compliance:

The materials specified here shall meet the following specifications and standards in their current edition.

UL Standards:

. Insulation tape
. Wire Connectors

NEMA Standards:

. Thermoplastic - Insulated WC 5 (IPCEA S-61-402)

GENERAL:

All wire and cable shall be listed by an "approved" third party testing agency.

Prior to energizing; feeders, sub-feeders and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be sent to the State Construction Office and the owner.

All wire and cable shall be run in raceway.

PART 2 PRODUCTS

CONDUCTORS:

All conductors shall be made of copper.

Conductors, unless otherwise noted, shall be heat and moisture resistant grade, thermoplastic insulated.

Conductors No. 6 AWG and smaller shall be stranded Class B copper conductors, Type THHN or THHW and continuously colored for desired phase identification.

Conductors No. 4 AWG and larger shall be stranded copper, Type XHHW-2 except otherwise noted and continuously colored for desired phase identification.

Branch circuit conductors for all lighting fixtures shall have a temperature rating of not less than what is required by the UL listing of the fixture with a minimum rating of 90 degrees C.

Except as otherwise noted on technical specification sections, conductors for signal and control circuits shall be stranded type, THHN or THHW as permitted by NEC.

Branch circuit conductors shall be not smaller than No. 12 AWG, except as noted here or on the drawings. Conductors for branch circuits whose length from panel to the first outlet in the circuit exceeds 50 feet for the 280/120 volt system shall not be smaller than No. 10 AWG, but not smaller than what is scheduled on panelboard schedule. Conductors for branch circuits whose length from the panel to the first outlet box in the circuit exceeds 125 feet for the 480/277 volt system shall not be smaller than No. 10 AWG, but not smaller than what is scheduled on panelboard schedule. Oversized conductors feeding branch circuit multi-outlet assemblies may be reduced, at the outlet box used to feed the multi-outlet assembly, to a size conductor rated to match the circuit breaker ahead of the circuit, if the use of the larger conductors will exceed the wiring capacity of the assemblies. Common neutral conductors for branch circuits are not permitted. **Each branch circuit shall have a separate, dedicated, neutral conductor.**

Conductors being connected to equipment shall have a temperature rating as required by the equipment manufacturer.

COLOR CODING:

Conductors, feeders, and branch circuits shall be color coded by phases as follows:

- Cables: Brady Permasleeve PSPT heat shrink type labels (printed on a Brady BMP61 label machine), or Panduit equivalent, or an approved equal, shall be used for conductors up to 500mcm

- All conductors in size up to 500 KCMIL shall have insulation that is continuously color coded.

- For instrumentation and control circuits, labels shall include three lines of text, and shall be the same on both ends of the conductor:
    - Line one: shall indicate the origination of circuit.
    - Line two: shall indicate the destination of the circuit.
    - Line three: brief description of circuit function
        - *Examples*:

          PLC-1-TB2-5 PLC-1-TB2-7
          MCC-1-Pump 1-TB-6 MCC-1-Pump 1-TB-7
          Run Status Stop Status

- Labels shall be readily visible, legible, and shall not be heat shrunk.

- Power conductors shall be phased as follows:
    - Conductors in size up to 500 KCMIL shall have insulation that is continuously color coded.
    - Conductors #4 and larger shall be phase taped:
        - 120/208 V, 3Ph/4W – Black, Red, Blue. Neutral – White.
        - 120/240V – 1Ph/3W – Black, Red, Neutral – White.
        - 480V – Brown, Orange, Yellow

PART 3 - EXECUTION:

INSTALLATION OF CONDUCTORS:

- NO splices shall be permitted in any manhole/hand holes, or in any feeder installation without express approval of Owners Electrical personnel. All conductors shall be installed complete from point of origin to point of termination.

- When conductors/cables cannot be terminated immediately and are potentially exposed to moisture, in manholes/handholes for example, the ends of the conductors/cables shall be sealed with heat shrinkable end caps not less than 3"- 4" in length to prevent moisture/water from "wicking" into the end of the conductor/cable.

- All conductors of a 3 phase circuit, whether installed as a single set or one set of a parallel, shall be of the same size and insulation type.

- All conductors shall be properly racked and supported to the wall of handhole/manhole using fiberglass reinforced polyester saddles.

- Cable Pulling Lube shall be Polywater "Type J" (or equal) high performance cable lube.

- All spares shall be terminated on terminal blocks and identified by labels indicating origination and destination of spare conductor.

- Control panels, disconnects, LV and PP panels, MCC's, etc, shall not be used as a raceway for conductors that are not specifically associated with the intended equipment.

- Where neutral conductors of different systems are installed in same raceway, wire trough, j-box, etc., the jacket shall be identified by the system associated with, by means of tracer stripe, other than green, on outer jacket.

Branch circuit conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes, troughs and gutters. Pull boxes may be utilized where required. If other than long radius bends are required, pull boxes sized in accordance with the NEC shall be used.

Do not run circuits of different voltage in same conduit.

Conductors in vertical runs shall be supported as required by NEC 300-19.

CONDUCTOR SEQUENCE AND ROTATION:

All feeders, sub-feeds to panels, motors, etc., shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C from front to rear, top to bottom, left to right when facing equipment.

CONNECTION OF OVERSIZED CONDUCTORS TO CIRCUIT BREAKERS AND SWITCHES:

When oversized branch circuit conductors are scheduled to be connected to circuit breakers, or switches, not having the capability to accept the larger conductor, provide splice in suitable junction box *as* close as possible to circuit breaker, as approved by the A/E, and connect to circuit breaker with the largest conductor that fit the circuit breaker. For similar situations for feeder, or large branch circuits, (circuit breakers rated 125 amperes and larger) provide lugs as required by feeder conductors.

END OF SECTION 26 0519

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SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL:

SCOPE:

Grounding and bonding of the electrical power system.

GENERAL:

The power distribution system shall be grounded at each voltage level. The conduit and neutral conductors of the wiring systems and all electrical equipment shall be grounded. The ground connection of the electrical system neutral and conduit system shall be made at the main service switchboard or main power device. A grounding grid shall be installed as indicated.

Each conductive, non-current carrying, part of the electrical system shall be bonded to an equipment grounding conductor sized in accordance with NEC.

The raceway system shall not be relied on as the sole grounding path for ground continuity. A *green* grounding conductor, properly sized per NEC Table 250-122, shall be run in all raceways (except telecommunications, data, and audio conductor's raceway) to ground each conductive, non-current carrying part of the electrical power system. This conductor shall be bonded to each metallic conduit, box and cabinet that is part of the related power system raceway.

The main service equipment bonding and grounding conductors, connections and ground rods are to be inspected and tested for proper function pursuant to NEC requirements. All resistance tests shall meet the test performance criteria. This contractor shall note any discrepancies within the system and provide to the owner for consideration a detailed list of modifications, corrections and associated costs to bring the system to proper operation.

All ground grid, ground ring, grounding tail, etc, system connections shall be FCI/Burndy HYGROUND Irreversible Compression Grounding type using the appropriate Hy-Press tool and die. **No Exothermic welds will be permitted.**

The smallest acceptable size for ground conductor shall be # 12 copper.

In all disconnects, control panels, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

Where additional grounds are installed on equipment, equipment supports, enclosures, etc. all terminations shall be made with compression crimps. Mechanical lug connections will not be accepted.

GROUND RESISTANCE TESTS:

Resistance to ground of grounding system shall be determined through ground resistance tests. The tests shall provide a true overall measurement of the resistance to ground, and of the entire physical integrity of the system.

Ground resistance tests shall be made in dry weather and in no case less than 48 hours after rainfall. Tests shall be conducted using the ratio method which measures the ratio of the resistance to earth on an auxiliary electrode. All measurements shall be in accordance with the Institute of Electrical and Electronic Engineers, Inc., Publication No. 550, dated May 1949, "Master Test Code for Resistance Measurement", Paragraph 3.43 - ration ohmmeter and as herein specified.

The indicating instrument shall be self-contained and shall include a direct current generator, synchronized current and potential reverse, cross current and potential coils, direct reading ohmmeter, series resistors, and range selector switch. The direct reading ohmmeter shall be calibrated for ranges of 0 to 20 and 0 to 200 OHMS on a scale logarithmic in character.

Associated Research, Inc. Vibroground instrument is acceptable.

Performance Criteria:

Resistance to ground shall not exceed 25 OHMS at any point of the system as measured in accordance with the requirements of this specification and including connection to main water pipe and bonding to structural steel, if any, and to rebar system.

Record of Ground Resistance Tests:

A certified record of ground resistance tests on the entire system shall be prepared and submitted for compliance to the Architect/Engineer and to the Owner upon completion of the tests.

The record shall be prepared and submitted for compliance to the Architect/Engineer and to the Owner upon completion of the tests. The grounding resistance test shall be performed by an independent testing company, engaged by the contractor, with not less than five years of experience in this type of work. The name of the testing company, along with its credentials shall be submitted to the Owner's representative with the contract bid. The test shall include the system connected to the main water pipe, structural steel, the rebar system and bonded to the lightning protection system (where applicable).

PART 2 - PRODUCTS:

GENERAL:

Products shall be new and listed for the use intended.

Equipment grounding conductors, for other than supplementary grounding system shall have 600 volt insulation and shall be as specified in Section 26 05 19.

Grounding conductors, where insulated, shall be colored solid green. Conductors intended as neutral shall be colored solid white on 120/208V circuits and natural gray on 277/480V circuits. Supplementary grounding field conductors shall be #1/0 AWG, bare stranded tinned copper conductors.

Clamps for attachment of grounding conductors to water pipes, etc. shall be of bronze or brass, with conduit hub with insulated bonding bushings and compression type lugs.

Ground rods shall be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10 feet long. The rods shall be rolled to a commercially round shape from welded copper clad steel manufactured by the electro-forming process and shall have a hard, clean, and smooth continuous copper surface. Ground rods shall be sectional type with cone shape point and shall be die stamped near top with the name or trademark of the manufacturer and the length of the rod in feet.

PART 3 - EXECUTION:

INSTALLATION AND WORKMANSHIP:

Installation of Grounding Rods: Grounding rods shall be installed with top of rod not less than 24 inches below grade, unless otherwise noted.

Installation of Supplementary Grounding System Conductors: Rod connecting grounding conductors shall be installed underground and under slab 24 inches below grade. Cables shall be installed in a straight and neat manner. The contractor shall protect the installed conductors against physical damage by means of temporary conduit, or other suitable means, until the entire installation is accomplished.

Conductors inside building shall be installed above non-air plenum ceilings at accessible locations, preferably mounted on walls. Conductors penetrating walls or floors shall be provided with sleeves. Support conductors at intervals not exceeding 6 feet.

Installation of Connectors: Connectors shall be installed in strict accordance with manufacturer's instructions.

Any feeder raceway anywhere in the system which enters a box or cabinet through part of a concentric knock-out shall be fitted with a bonding bushing and jumper. The jumper shall be sized by NEC Table 250-94 and be lugged to the box.

Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250-66 and lugged to the box.

Ground Resistance Tests: Refer to Part 1 of this specification.

END OF SECTION 26 0526

SECTION 26 05 27 — TELECOMMUNICATIONS GROUNDING

PART 1 — GENERAL

SUMMARY:

This section includes providing a backbone telecommunication grounding system for the use of telecommunication system installer to bond the telecommunication infrastructure specified under Division 27.

RELATED SECTIONS:

Section 26 05 19 — Building Wire and Cable
Section 26 05 26 — Grounding and Bonding

SUBMITTALS:

Submit product data for fire rated material used as required herein under provisions of Division-01 and the General Provisions of the Contract.

Submit product data for the following:

. TMGB busbar

REFERENCES:

ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for telecommunications.

All work and materials shall comply with the latest rules, codes and regulations, including but not limited to the following:

. Occupational Safety and Health Act Standards (OSHA)
. NFPA 70 - National Electrical Code (NEC)
. ANSI/IEEE C-2 National Electrical Safety Code
. All other applicable Federal, State, and local laws and regulations.

BONDING & GROUNDING INFRASTRUCTURE:

The grounding system specified here shall be installed in a way that it passes the tests specified under Division 27. Provide all additional wiring materials and labor to install a system that is satisfactorily tested.

MTGC (Main Bonding Conductor) (referred to in TIA/EIA-607 as the Bonding Conductor for Telecommunications): The copper conductor that bonds the TMGB to the service equipment (power) ground.

TMGB (Telecommunications Main Grounding Busbar): A copper ground reference busbar, typically installed in the entrance facility or entrance room, and is bonded to the service equipment (power) ground by the Interconnecting Bonding Conductor.

PART 2 – PRODUCTS

MATERIALS:

Refer to the General Conditions, Supplementary General Conditions, and Division-1 General Requirements.

Telecommunication Main Grounding Busbar (TMGB):

Acceptable Manufactures: Newton Instrument Company, or approved equal, 1/4" x 4"x 20" insulated copper ground bar.

Bonding Conductors:

All bonding conductors shall be insulated copper. Exception is use of flat, braided, aluminum ground straps utilized for bonding sections of aluminum cable tray.

Unless otherwise specified, size the conductors as required by NEC.

Use #2 stranded copper to bond TMGB to 208/120 volts power panelboard equipment grounding bar and building structural steel.

Bonding Conductor Terminations:

Acceptable Manufacturers: Thomas and Betts, ILSCO, Square D or approved equal.

Acceptable Materials:

. Two hole compression lugs: "Two Hole Lugs Long Barrel Type" color code blue, high conductivity wrought copper, electro tin plated, or approved equal. Use to bond conductors to TMGB and to any other bonding application.

PART 3 – EXECUTION

PREPARATION:

Site and materials preparation for testing is the responsibility of Contractor.

INSTALLATION:

In the Telecommunications Closets, Equipment Rooms, and Entrance Facilities provide all local bonding as specified on the drawings and in the specifications.

Ground electrical systems and equipment as required by code, utility, local ordinances, and requirements herein.

All insulated ground bars must be isolated from the structural support by a 2" minimum separation, using manufacturer's recommended insulating stand-offs and hardware.

Clean ground bars prior to terminating conductors.

Label all main telecommunications bonding conductors as close as possible to their termination point.

Bond the TMGB to the service equipment (power) ground, typically located in the electrical entrance facility, utilizing the most direct route possible to minimize conductor length. Bond each TMGB to 208/120 volts panelboards used to power receptacles in same area served by telecommunications closet.

END OF SECTION 26 0527

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SECTION 26 05 29 -SUPPORTS AND FASTENERS

PART 1 - GENERAL

SCOPE OF WORK

Work Included: Work under this Section includes but is not necessarily limited to the following:

. Supports and fastenings required for properly mounting of boxes, raceways, electrical equipment and fixtures.

APPLICABLE PUBLICATIONS:

The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.

Federal Specifications (Fed. Spec.)

RR-W-401C Wire Rope and Strand

American National Standard Institute, Inc., (ANSI) Standards.

B 18.2.1-1972 Square and Hex Bolts and Screws, Including Hex Cap Screws and Lag Screws

B18.2.2-1972 Square and Hex Nuts

American Society for testing and Materials (ASTM)

A307-80 Carbon Steel Externally Threaded Standard Fasteners

A576-81 Steel Bars, Carbon, Hot-Wrought, Special Quality

A325-81 High Strength bolts for Structural Steel Joints

Underwriters Laboratories, Inc., (UL) Standards

Building Materials Directory (January 1981 with Quarterly Supplements)

UL57 Electric Lighting Fixtures (Aug. 30, 1972, 12th Edition; Errata Sept. 23, 1975; Rev. thru Sept. 12, 1980)

Seismic Supports Submittal:

Submit as part of Division 26 work, proposed method and details to support and restrain the equipment listed here against seismic disturbances. This information shall be prepared by seismic design engineer registered in North Carolina. This equipment has an importance factor of 1.5 and includes:

. Emergency egress light fixtures and exit light fixtures
. As otherwise required by Building Code.

The submittal shall be prepared by an outfit with proven seismic engineering experience in this type of service and shall be certified by a professional structural engineer registered in North Carolina. Submit qualifications of proposed outfit to A/E as part of materials list submittal. Organizations with recognized proven experience are VMC-Southeast, Inc., 19901-E Henderson Rd. Cornelius, NC Contact: John Crowley @ 704-896-3255 or fax @ 704-896-3256 and Seismic Control & Isolation, Inc., 11160 Downs Road, Pineville, NC 28134, Mr. Will Meckstroth Phone: 704-504-8780, Fax: 704-504-9573, or Synergy Engineering, PA Tel. No. 704-405-3810. Other companies are equally acceptable upon submission of evidence of proven experience.

Provide quality assurance services, as applicable and as required by the NCSBC for equipment and systems specified under this contract. These services shall be provided by a professional engineer registered in the state where the project is located and working for the contractor at the contractor's expense.

Provide assistance with the special inspections of the anchorage of the electrical equipment specified here, as applicable, in accordance with requirements of NCSBC. The inspections shall be accomplished at the Owner's expense by qualified engineer.

PART 2 - PRODUCTS

MATERIALS:

Steel Supports:

ALL interior and exterior conduit and equipment installations shall be rigidly supported, having all supports and mounting hardware, including all all-thread rod, nuts, bolts, & washers; made of 304 stainless steel.

Mounting Hardware shall be defined as: nuts, bolts, washers, all-thread rod, and anchors.

Supports shall be considered as including, but not limited to, all framing materials such as

channel strut and channel strut fittings, mounting plates/back plates, beam clamps, strut straps, one-hole straps with clamp-backs, & mineralac straps.

WALL ANCHORS:

Interior Masonry or Concrete Walls: Stainless steel expansion bolt anchors designed to match the load, seismic requirements and type wall construction, but not smaller than 1/4".

Exterior Precast Concrete Walls: Stainless steel expansion bolt anchors with penetrations limited as approved by Architect.

Interior Dry Walls: Stainless steel toggle bolt anchors designed to match the load and seismic requirements, but not smaller than 1/4".

Conduits installed on the interior or exterior of building walls shall be spaced off of the wall surface a minimum of ¼" inch using "clamp-backs" or strut.

BEAM ANCHORS:

Install expansion bolt anchors designed to match the load and seismic requirements.

All anchor holes drilled in reinforced concrete beams or concrete joists shall avoid cutting the reinforcing bars.

All heavy loads such as transformer trapeze anchors shall be reviewed with the Architect prior to installation.

RODS:

Provide stainless steel threaded steel rods, where required, size as required by load and seismic requirements but not less than ¼ inch diameter. Use stainless steel on all exterior locations. Do not *use* chain except where detailed or specifically required. Do not use perforated strap or wire.

PART 3 - EXECUTION:

PREPARATION:

Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

Prior to installation of hangers, supports, anchors, and associated work, the contractor shall meet at the project site with Construction Manager, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purposes of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

REPLACEMENT OR REMOVAL OF EQUIPMENT:

Consideration shall be given to the potential replacement or removal of equipment in the selection of anchors or fasteners. When it can reasonably be assumed that equipment will be replaced, anchors and fasteners that can be reused or replaced shall be used. When it can reasonably be assumed that equipment will be removed, anchors and fasteners that have protruding parts, such as bolts or studs, shall not be used. If the protruding part can be removed or driven flush with the base material, such anchors or fasteners may be used.

INSTALLATION:

Anchors and fasteners shall be installed in accordance with the manufacturer's directions. Necessary holes shall be drilled with drills recommended by the manufacturer and shall be of the recommended diameter and depth. The drilled holes shall be left rough, not reamed, and shall be free from any drill dust. Screws installed in wood or other material shall be so located as to be such distance away from joints as not to be loosened upon opening of joints with shrinkage of the material. Screws, bolts, nuts, or other devices used with anchors or fasteners shall have standard threads and heads and be of a type and size recommended by the manufacturer of the particular anchor or fastener being used.

RACEWAYS:

Rigid conduit supports shall be provided at least every 8' and within 3' of each outlet box, junction box, cabinet or fitting.

All pipe supports shall be of type and arrangement as hereinafter specified. They shall be so arranged as to prevent excessive deflection and avoid excessive bending stresses.

Provide all stainless steel and concrete required for support and anchoring of pipes other than shown on Structural or Architectural Drawings. A/E shall approve method of hanging before work is started. This contractor shall bear all responsibility for materials and workmanship as described in this section and shall make sure that all hangers and supports are properly and permanently connected to building structure.

All supports shall be designed to avoid interference with other conduit, hangers, ductwork, building structures and equipment.

SAFE WORKING LOAD:

To compensate for variations in products and job conditions, anchors and fasteners, including screws, bolts, or other devices used with them, shall have a minimum safe working load of 1/4 of the holding power. The holding power of an anchor or fastener shall be based upon laboratory test and certified by the manufacturer. Safe working load may also be determined as 1/4 of a proof test load. A proof test load is a predetermined load that an anchor or fastener must support without failure. The actual holding power might be greater than the proof load.

The type of anchor or fastener to be used shall be designed and intended for use in the base supporting surface to which the item or support is to be attached. As a general rule, wood screws should be used on wood, masonry anchors on concrete or brick, toggle bolts or similar on hollow or thin units, and machine screws, bolts, or welded studs on steel. Some anchors and fasteners are intended for and may be used on more than 1 base material. For example, some anchors intended for concrete may apply also to hollow masonry units. Other anchor and fastening devices specifically designed for the purpose may be used for their intended application. These include concrete inserts, continuous slot channels, beam clamps, friction, and spring clamps, etc.

ATMOSPHERE:

Anchors and fastenings and screws, bolts, or other devices used with them, shall have corrosion resisting characteristics for the atmospheric conditions in which they are installed.

RESTORATION OF STRUCTURAL AND BUILDING FIREPROOFING:

Restore to original condition any portion of structural or building fireproofing material damaged or removed during the installation of fastener or supports.

SPECIAL REQUIREMENTS FOR SEISMIC PROTECTION:

Requirements specified here shall be considered minimum requirements subject to change in accordance with approved seismic supports submittal.

Sway Braces - General:

Sway braces shall be installed on cable tray and electrical conduit not otherwise rigidly anchored to preclude damage during seismic activity as follows:

All electrical conduit 2-1/2" and larger.

Conduits suspended by individual hangers 12" or less in length from the top of conduit to the bottom of the structural support for the hanger, do not require sway braces.

Provisions of this paragraph apply to all electrical conduits within a 5' line around outside of building unless buried in the ground. Electrical conduit grouped for support on trapeze type hangers will be braced at the same intervals as hereinafter provided for individual conduit runs, with details increased in cross sectional area proportionate to the increased weight per linear foot of conduit and contents supported at each trapeze hanger. No trapeze type hanger will be secured with less than two 1/2" bolts.

. Sway Braces for Conduits, Busduct, and Cabletray:

. Transverse sway bracing shall be provided at 30' intervals for conduits 4" size and smaller.

. Sway bracing for cable tray shall be provided at 20 feet intervals.

. Longitudinal sway bracing shall be provided at 40 feet intervals.

. Sway Braces for Busduct: Shall be provided at 10 feet intervals.

. Bolts used for attachment of anchors to conduit and structure shall be not less than 1/2" in diameter.

Anchor rods, angles and bars shall conform to the following Table depending on length:

Bracing Materials Schedule

| TYPE BRACE | MAXIMUM ACTUAL LENGTH |
|---|---|
| Angles | |
| 1-1/2 x 1-1/2 x 1/4" | 4′-10″ |
| 2 x 2 x 1/4" | 6′-6″ |
| 2-1/2 x 2-1/2 x 1/4" | 7′-0″ |
| 2-1/2 x 2-1/2 x 1/4" | 8′-2″ |
| 3 x 2-1/2 x 1/4" 8'-10" | 8′-10″ |
| 3 x 3 x 1/4" 9'-10" | 9′-10″ |
| | |
| Rods | |
| 3/4" | 3′-1″ |
| 7/8" 3'-7" | 3′-7″ |
| | |
| Flat Bars | |
| 1-1/2 x 1/4" 1'-2" | 1′-2″ |
| 2 x 1/4" 1'-2" | 1′-2″ |
| 2 x 3/8" l'-9" | 1′-9″ |

| Conduit | |
|---|---|
| 1" (Schedule 40) | 7'-0" |
| 1-1/4" (Schedule 40) | 9’-0” |
| 1-1/2" (Schedule 40) | 10’-4” |
| 2" (Schedule 40) | 13'-1" |

Flexible Couplings or Joints:

Flexible couplings are not required on underground electrical utility conduits. Slack will be provided in underground cables whenever such cables enter or exit rigid appurtenances.

ANCHOR BOLTS:

All floor or pad mounted packaged electrical equipment will have a minimum of 4 anchor bolts securely fastened through bases. Anchor bolts shall have straight length equal to at least 10 times the nominal diameter of the bolt and shall conform to the following table of sizes for various equipment weights.

| Maximum Equipment Weights | Minimum Bolt Sizes* |
|---|---|
| 500 pounds | 3/8” |
| 1,000 pounds | 1/2" |
| 5,000 pounds | 5/8" |
| 10,000 pounds | 3/4" |
| 20,000 pounds | 7/8" |
| 30,000 pounds | 1" |
| 50,000 pounds | 1 1/4" |

* Based on 4 bolts per item, use equivalent total cross sectional areas when more than 4 bolts per item are provided.

Anchor bolts which exceed normal depth of equipment foundation piers or pads shall either extend into concrete floor, or the foundation shall be increased in depth to accommodate bolt lengths.

EQUIPMENT SWAY BRACING:

Equipment sway bracing shall be provided for all items supported by off-the-floor structures or structures suspended from floors or roof above. Braces shall consist of angles, rods, bars, or pipes run at a 45-degree angle from the equipment frame to the building structure secured at both ends with not less than 1/2" bolts. Braces shall conform to the bracing material schedule. Bracing shall be provided in 2 plans of directions, 90 degrees apart, for each item of equipment.

In lieu of diagonal bracing applied to vertical support structures from floor or roof above, items may be supported with hangers inclined at 45 degrees, provided supporting members are properly sized to support full operating weight of equipment when hangers are 4 inclined at a 45 degree angle.

LIGHTING FIXTURES:

Provide fixtures and support suitable to withstand seismic disturbances without damage. Luminaries supports will employ materials which are suitable to the seismic zone. In addition to the regular fixture support requirements, provide the following seismic protective support features.

. Recessed individual or continuous row of fixtures shall be provided with fixture support wires attached to the building structural members using 2 wires for individual fixtures and 2 wires per unit of continuous row fixtures. These support wires (minimum No. 12 gauge wire) will be capable of supporting 4 times the support load. In addition, lay-in fixture shall be affixed to grid system. As specified in Section 26 51 00 and per ASTM-E-580.02.

. Support wires shall allow for the fixture to drop 12" below ceiling.

. Surface mounted individual or continuous rows of fixtures shall be attached to a support suitable for the seismic zone specified. Fixture support devices for attaching to suspended ceilings shall be a locking type scissor clamp or a full loop band which will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixtures. Each wall mounted light fixture shall be secured in a manner to hold the unit in place during a seismic disturbance.

. Loop and hook or swivel hanger assemblies for pendant fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendant supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall 31 not cause sharp bend in conductors or damage to insulation.

. Suspension systems for light fixtures as installed that are free to swing a minimum of 45 degrees from the vertical in all directions without coming in contact with other parts of the building, and will withstand, without failure, a force of not less than 4 times the weight it is intended to support will be acceptable.

END OF SECTION 26 0529

SECTION 26 05 31 - CONDUIT

PART 1 - GENERAL

SCOPE OF WORK:

Provide conduit as specified here. All conduits other than in equipment rooms, storage rooms, attic and in lower level corridors without ceilings, shall be run concealed in walls or above ceiling. Provide all work required to conceal conduit as specified including all cutting, trenching, patching, refinishing and painting of new and existing walls and ceilings, as required to conceal new conduit.

RELATED WORK SPECIFIED ELSEWHERE:

Section 26 0535 - Conduit and Other Requirements for Data and Voice Cabling
Section 26 0537 - Sleeves and Penetrations
Section 26 0539 - Fire Seals

ABOVE GROUND CONDUIT:

Minimum size conduit for above-ground applications shall be 3/4-inch, except as otherwise noted.

Conduit shall be sized in accordance with the latest edition of the NEC unless larger conduit is indicated on drawings. Flexible water tight metal conduit in size 1/2 inch is acceptable for lighting fixture connections not exceeding 6 feet in length, provided green wire is installed, NEC is followed and the conduit is third party approved for such use. Flexible water tight conduit shall be used, as applicable for final connection to motors, appliances and transformers. Length shall not exceed six feet. Flexible water tight metallic conduit will not be used as a general wire method.

All exterior above ground conduit shall be PVC coated rigid steel.

PVC-Coated rigid steel conduit shall be installed in all outdoor locations, process areas, areas of high humidity, and wash down areas. Conduit damaged during installation shall be replaced at contractors' expense.

- All threaded conduit ends shall be coated with an electrically conductive, corrosion resistant compound during installation of conduit per NEC Article 300.6(A). (i.e. *T&B "Kopr-Shield"*).
- Conduit damage shall be determined by Owners Electrical personnel.
- The use of a Tinker & Rasor holiday detector may be used at the discretion of the Owners Electrical personnel.
- NO PATCHING of damaged PVC-Coated conduit will be allowed.

PVC Schedule 80 conduit shall be installed in all chemical and chlorine locations.
GRS Conduit shall be installed in all indoor, non-process locations. For example: Electrical Rooms, Generator Buildings and enclosures, Blower Rooms, Dry Pump rooms, Maintenance Shops, pipe galleries, etc.

Conduit fittings/pull points shall be installed so that they are accessible from a 10′ ladder, unless installed in an area that would allow readily accessibility by a man-lift.

All interior (whether GRC or PVC-Coated) and exterior conduit installations shall have supports and mounting hardware, including all nuts, bolts, & washers; made of 304 stainless steel.

Nickel Anti-seize (for use on stainless steel) shall be used on all stainless steel machine screws and bolts to help prevent seizing/galling.

In unclassified areas, conduit connections to instruments, motors, and other equipment with moving parts shall be liquid tight flexible non-metallic conduit and fittings.

- Maximum. length of liquid tight flex, metallic and non-metallic, shall be 36″.
- Minimum. length of liquid tight flex, metallic and non-metallic, shall be 12″ for trade sizes ½″ to 1″. For trades sizes 1-¼″ and larger, minimum length shall be 18″.
- Where metallic liquid-tight is installed in a corrosive area or connected to PVC-Coated conduit, PVC-Coated liquid-tight fittings shall be used.
- Type ATLA liquid-tight flex shall be used in locations where high temperatures are possible. *For example: engine-generator sets*.
- All bushings and conduit hubs shall be grounding type.

Conduit shall be installed at minimum of 6″ from high temperature piping, ducts, etc.

Conduits whether PVC-Coated, GRC, or PVC-Schedule 40, crossing structural joints where movement is allowed shall have concrete-tight and water tight expansion/deflection fittings.

Conduits installed in walls or slabs which have reinforcing in both faces, shall be installed in-between reinforcement. Where only one layer of reinforcing, conduit shall be placed under reinforcement.

Conduits shall be terminated into an enclosure with fittings that do not violate the NEMA rating of the enclosure.

Conduits in slabs and walls shall be photographed and measured coordinates taken, prior to concrete pour.

Unless variance is approved by Owners electrical personnel, all exposed conduit penetrations

and/or stub-ups turning up out of a slab, which are unable to be continued on, completed, or terminated at designated enclosure, junction box, device, etc., at the time of installation due to construction, shall be the same height to maintain aesthetic appearance.

Conduit ends shall also be made the same height where bottom entry of floor/pad mounted electrical switchgear, equipment, enclosures, etc, is required.

Conduit installations exceeding 10' horizontally along handrails shall not be supported from handrails.

Conduits marked for spare shall have a #12 stranded pull wire installed for future use.

STG Type conduit hubs shall be used for bonding purposes

Pulling elbows, 1-½" and larger shall be mogul type fittings.

Conduit sealing fittings shall be expanded fill type to accommodate 40% conductor fill (i.e. Appleton EYSEF; meets 40% fill, suitable for vertical and horizontal installation). Sealing compound applications shall be witnessed by Owners Electrical personnel.

Conduits containing intrinsically safe circuits shall have fittings sealed with fire caulk to prevent transfer of hazardous gases.

The raceway system shall not be relied upon as the only method for grounding continuity. See Section 26 0526, GROUNDING AND BONDING for clarification.

UNDEGROUND / COVERED CONDUIT:

PVC Schedule 40 conduit may be installed in slabs, masonry walls and duct-banks for feeder and branch circuits, with the exception of instrumentation, telephone, data highway, fiber optic circuits, and motor feeders controlled by VFD's (*or VFD controlled*) motor feeders. Conduits for these type circuits shall be installed in GRC.

- PVC-Coated rigid steel conduit, nipples or 90 degree elbows as applicable, shall be installed for all exposed conduit transitions from slab, wall, or duct-bank, prior to emergence from concrete. Transition from PVC Schedule 40 conduit to PVC-Coated conduit, shall be done a minimum of 24" prior to conduit emergence.
- GRC or PVC-Coated rigid steel 90 degree elbows shall be installed within planes of duct-banks, slabs, and walls
- PVC-Coated shall extend through and above slab minimum of 16" on all exposed conduits.
- All elbows shall be large radius type.

APPLICABLE SPECIFICATIONS AND STANDARDS:

The materials specified here shall meet the following specifications and standards in their current edition.

UL Standards:

. Electric. Metallic Tubing
. Flexible Metal Conduits-UL-1
. Rigid Metal Conduit UL-6
. PVC Coated Rigid Metal Conduit – UL-651, NEMA TC2

NEMA Standards:

Electric plastic conduit TC-2.

ANSI Standards:

. Specifications for Rigid Steel Conduit, Zinc Coated, ANSI C80.1.

PART 2 - PRODUCTS:

RIGID METAL CONDUIT:

Galvanized rigid metal conduit (`GRC') shall be schedule 40, of the best quality steel.

The interior and exterior surfaces of the conduit shall be protected with a metallic zinc coating. Rigid steel conduit shall be galvanized by the Hot-Dip process in accordance with ASTM A 123.

Fittings for `GRC' shall be threaded type, UL listed.

Electric Metallic Tubing:

Electrical metallic tubing (`EMT') shall be rigid metal conduit of the thin-wall type in straight lengths, elbows or bends for use as raceways for wire or cables in an electrical system.

Flexible Metallic Conduit:

Flexible metallic conduit shall conform to UL standard 'Flexible Steel Conduit'. All steel used in the fabrication of the conduit shall be zinc coated.

Liquid-tight flexible steel conduit shall be provided with a protective jacket of polyvinyl chloride extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals and corrosive fumes.

Rigid Non-Metallic Conduit:

Schedule 40 (EPC-40), or Schedule 80 (EPC-80)heavy wall polyvinyl chloride plastic conduit and fittings, UL listed, suitable for 90 degree C. conductors.

Intermediate Metal Conduit:

Intermediate metal conduit (IMC) shall be zinc coated steel, UL listed and labeled.

TERMINATIONS:

IMC and GRC shall terminate with either a double locknut/bushing set, or in *a* threaded hub.

Where concentric, eccentric or oversized knockouts are encountered, a grounding-type insulating bushing shall be provided.

EMT terminations shall be made utilizing plated steel hexagonal compression - UL listed. No set-screw type fittings shall be allowed.

Metallic conduit connectors shall be nylon-insulated.

CONDUIT COUPLINGS:

Conduit couplings for IMC, GRC and PVC shall be in accordance with the NEC.

EMT couplings shall be of the plated steel hexagonal compression type - U.L. listed. No set-screw type fittings shall be allowed.

PART 3 - EXECUTION:

INSTALLATION OF CONDUIT AND TUBING:

See Section 26 05 29 for additional support requirements.

Conduits shall be capped (not taped) during construction to prevent the entrance of water, dirt, and other debris in the conduit.

Metallic raceways shall not be stored exposed to the weather.

Inside building conduit shall not be supported on, or from, suspended ceiling grid.
Conduits shall be installed in such manner as to insure against trouble from the collection of trapped condensation, and all runs of conduit shall be arranged so as to be devoid of traps where feasible. The contractor shall exercise the necessary precautions to prevent the lodgment of dirt, plaster, or trash in conduit, tubing, fittings, and boxes during the course of installation. A run of conduit or tubing which has become clogged shall be entirely freed of these accumulations or shall be replaced.

The use of "LB's" shall be limited where possible. Where necessary to use "LB's" sized above 2-inch, mogul units shall be installed.

Insulated bushings of molded bakelite shall be used on all conduit entrances, one inch over in size, into junction boxes, panel boxes and motors starters having sheet metal enclosures.

The continuity of metal raceways shall be maintained when using Teflon tape or similar products on conduit joints.

INSTALLATION OF UNDERGROUND CONDUIT:

Minimum cover to top of conduit shall be 18" or as required by NEC. Any depth less than 18" shall be approved by Owners Electrical personnel prior to installation. A red, plastic encased aluminum, underground caution tape marked "**Caution: Buried Electrical Line Below**" placed 12" above conduit for entire length of run.

Conduits installed under vehicular traffic areas shall be a minimum of 24" below grade.

All PVC Schedule 40 conduits shall have bell ends where terminated at walls.

A ground rod shall be driven at every handhole/manhole. Where conduits terminate at handholes/manholes, the equipment grounding conductor shall be connected to the ground rod. All metal conduits terminating in handholes/manholes shall also be bonded to the equipment grounding conductor.

- Where ground conductor ends at control panel, junction box, etc. support stands, make provision to terminate on stand.

Handholes/manholes shall be installed so that they sit 12" AFG. All covers shall be square, aluminum hinged lids, full access. (*Bilco Type J or equal*)

Minimum size underground conduit shall be 1"

Area and Street Lighting conduit shall be direct buried 30" below grade in 12" of sand, 9" above and 3" below conduit, installed in PVC Schedule 40 conduit. A red plastic encased aluminum underground caution tape marked "**Caution: Buried Electrical Line Below**" shall be placed 12" above conduit for entire length of run.

Conduit for power and controls shall be PVC Schedule 40.

Instrumentation, telephone, and data highway (whether fiber or copper) circuits shall be installed in GRC or PVC-Coated GRC.

- Instrumentation, telephone, and data highway (whether fiber or copper) circuits shall be installed in designated control handholes separate from handholes containing power/lighting circuits.

Bend radius of all underground conduit shall be a minimum 24".

Prior to emerging out of concrete or earth in outdoor installations, non-metallic conduit shall be connected to PVC-coated rigid conduit 90 degree elbows and emerge as PVC-coated rigid conduit. All horizontal 45 degree elbows and greater will be rigid galvanized conduit.

Spare conduits or conduits having conductors removed shall have a #12 stranded wire installed as a pull wire.

For conduits 2" and larger, a mandrel shall be pulled through any new or existing conduits to be re-used prior to conductor installation.

On pole risers, or other electrical structures requiring risers (i.e. H Structures), conduit shall be concrete encased 24" above finished grade. Risers shall be installed to within acceptable distance of cable termination points. If not designated on drawings, height shall be confirmed and accepted by Owners Electrical personnel.

CONDUIT SEAL:

Conduit penetrations through new exterior walls and new building perimeter walls shall be accomplished utilizing Link-Seal wall penetration system, O.Z. Gedney FSKJFSKA waterproofing fittings or approved equivalent system.

For applications where the wall exists, utilize Link-Seal or approved equal sealing fitting appropriate for the size of the conduit penetrating wall. Core drill the wall to create a smooth hole of dimensions suitable for the conduit to be installed. Sealing fittings shall be modular Link-Seal module 'C' suitable for use in water, direct ground burial and atmosphere conditions comprising of EPDM seal elements, reinforced nylon polymer pressure plate, and 2-part zinc dichromate corrosion inhibiting coated steel bolts and nuts.

All conduits entering from a ductbank system coming into a building, or directly into the bottom of an MCC, Switchgear, MV Gear, PLC, etc., shall be sealed using expandable foam to prevent water/moisture and/or possible entry of hazardous gases coming through a manhole and entering the equipment through the raceway.

- Expandable foam shall be Polywater FST Foam Duct Sealant (*conduits 2" and larger*) or Polywater FST MINI (*conduits 1-1/2" and smaller*) or approved equal.

- Depth of conduit sealing shall be the diameter of the conduit, or per manufacturer's installation instructions.

EXPANSION FITTINGS:

Where conduits of any type pass over a building expansion joint, a standard "expansion joint fitting," compatible with the type raceway being used, shall be provided.

IDENTIFICATION:

All Conduits, terminating at junction boxes, wiring troughs, equipment, MCC's etc., shall be identified with a laminated conduit legend and permanently secured to the inside of the enclosure cover/door, indicating the end destination of conduit. Size of laminated legend shall be 8½" x 11".

- For smaller junction boxes, wiring troughs, etc., where there is not enough room to practically secure the laminated conduit legend, or where an 8½" x 11" legend is too large to fit, or where unable to permanently secure on the cover or door due to other devices installed on the cover/door, the laminated legend shall be appropriately sized and method of installation approved by the Owners Electrical personnel.

Conduits entering manhole/handholes shall have a phenolic legend plate permanently attached on each wall of the manhole/handhole, with conduit entry, indicating circuit number and end destination. Minimum size of phenolic legend plate shall be 8½" x 11"

END OF SECTION 26 0531

SECTION 26 05 37- SLEEVES AND PENETRATIONS

PART 1 - GENERAL:

SCOPE:

Provide sleeves, seals and openings for raceway penetrating exterior walls, interior masonry walls and partitions, floors, and roofs as specified here. All sleeves, seals and openings required shall be located and provided by this Contractor for his portion of the work.

PART 2- PRODUCTS

CONDUIT SLEEVES, SEALS AND ESCUTCHEONS:

Provide sleeves for each conduit passing through walls, partitions, floors and roofs.

Sleeve Material:

Type
Designation

1 18 gauge, adjustable or fixed length, galvanized steel, Pipe Shields Inc. or equal.

2 Standard weight galvanized steel pipe or conduit.

3 Standard weight galvanized steel pipe or conduit with a continuous weld stop of ¼" steel plate extending outside of sleeve a minimum all around, similar to R&S Manufacturing Corp. Fig. 204.

4 Cast iron pipe sleeve with center flange, similar to James B. Clow and Sons No. F-1430 and F-1435.

5 Standard weight galvanized steel pipe with flashing clamp device welded to pipe sleeve or watertight sleeves, similar to Josam 1870-A2, 1870, 1940-C with oakum and lead caulking compound.

Sleeve Sizes:

Sleeves for conduit or cables shall be adequate size to accommodate a minimum of ½" clearance between inside of sleeve and outside of pipe.

Sleeve Lengths:

| Location | Sleeve Length |
|---|---|
| Floors | Equal to depth of floor construction including finish. In waterproof floor construction sleeves to extend minimum of 2" above finished floor level. |
| Walls and Partitions | Equal to thickness of construction and terminated with surfaces. |

Sleeve Caulking and Packing:

| Type Designation | Caulking and Packing Requirements |
|---|---|
| A | Space between metallic conduit and sleeve, or if hole is core drilled between conduit and wall, be provided with waterproofing seal method specified under Section 26 05 31. |
| B | Space between conduit or cable, and sleeve shall be caulked with a fire resistant foam sealant. This applies also to all telecommunication wiring sleeves and conduits penetrating fire rated walls or floors. |
| C | Space between conduit or cable, and sleeve shall be packed with mineral wool and sealed tight with caulking. |

| **Sleeve Application** | | |
|---|---|---|
| Sleeve Type | Location | Sleeve Caulking &Packing Type Designation |
| 1 | Interior fire rated walls, partitions and floors | B |
| 1 | Interior non-fire rated stud walls and partitions | C |
| 1 | Interior non-fire rated masonry walls and | C |
| 2 | Membrane, waterproof floor and wall | B |
| Note: Another trade will install membrane up around sleeve and inside sleeve | | |
| 3 or4 | Exterior walls | A |
| *5* | No membrane, waterproof, roof and wall construction where flashing is required. | A or B |

Escutcheons:

Provide escutcheons on all exposed conduit passing through walls, floors, partitions and ceilings. Escutcheons shall be held in place by internal spring tension or set screws.

Application:

| Location | Escutcheon Material |
|---|---|
| Finished spaces | Anodized aluminum, chrome-plated brass |
| Unfinished spaces, excluding mechanical equipment rooms | Plain brass, cast iron or aluminum |

PART 3- EXECUTION:

PLACEMENT OF SLEEVES:

Sleeves shall be furnished and placed and openings located as construction proceeds and in ample time to avoid delay to the work. After construction of wall or floor has been accomplished remove the sleeve and proceed to install raceway or pipe, except that sleeves through floors with membrane waterproofing, fire rated gypsum or plaster drywalls and smoke partitions, shall remain in place properly secured to the slabs or wall.

Where sleeves or grouped raceway and pipe are to be installed in openings concurrent with or subsequent to construction, such items shall be securely fastened in place and the opening filled and patched with material approved for the particular construction.

Sleeves and openings shall be protected during all phases of construction. Care shall be taken to prevent concrete, plaster or other construction material from closing.

END OF SECTION 26 05 37

SECTION 26 05 41 - BOXES & ENCLOSURES

PART 1 - GENERAL

WORK INCLUDED:

Work under this Section includes but is not necessarily limited to the following:

(1) Outlet Boxes
(2) Cabinets and Enclosures
(3) Access Doors

RELATED WORK SPECIFIED ELSEWHERE:

Section 26 0535 — Conduit and Other Requirements for Data and Voice Cabling
Section 26 0553 — Electrical Identification

APPLICABLE SPECIFICATIONS AND STANDARDS:

Equipment specified in this Section shall meet the following specifications and standards.

UL Standards

. Electric Cabinet and Boxes
. Outlet Boxes and Fittings

NEMA Standards

. Boxes, 051

QUALITY ASSURANCE:

The contractor, through the manufacturer of the equipment specified here, shall review the use, details, and methods of installation of his product as indicated and shall disclose to the Architect any and all deviations from his recommended use and method of installation and shall also disclose to the Architect his recommendations for the use and method of installation of his product to achieve the intended purpose and result. Such disclosure shall be made within the time stipulated for submission of shop drawings.

SUBMITTALS:

Submit manufacturer's catalog data on all products specified here.

PART 2 PRODUCTS

OUTLET BOXES, PULL BOXES, CABINETS AND ENCLOSURES:

Boxes:

Unless otherwise specifically noted, all power boxes shall be NEMA 4X made of 304 Stainless Steel and shall have ¼ turn latches.

Enclosures installed in Class 1, Div 1, Div 2 and Div 2 areas shall be rated NEMA 7, cast aluminum.

Unless being installed inside the office or shed all device / outlet boxes shall be cast aluminum.

Disconnecting means on control panels shall not be "Plastic Type."

Boxes shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70, Article 370. O

Fixture outlet boxes on ceiling shall be not less than 4 inch octagonal. Fixture outlet boxes in concrete ceiling shall be of the 4 inch octagonal concrete type, set flush with the finished surface. Fixture outlet boxes on plastered ceilings shall be fitted with open covers set to come flush with the finished surface.

Switch and receptacle outlet boxes, and boxes used to feed surface raceways, in dry construction walls, plastered walls and pour-in concrete walls shall be not less than 4 inches square, or 4 11/16" x 4 11/16" if required by the contained conductors, with appropriate extension to set flush with the finished surface. Depth of boxes used for power circuits shall be not less than 1 1/4-inch deep except that deeper boxes shall be used as required by wiring devices, conductors or wall construction requirements. One-piece gang or gangable boxes not less than 2 inches deep shall be utilized where the use of 4-inch square boxes is not feasible. The depth of the boxes shall be increased as required by the thickness of the surface materials.

Outlet boxes for use with conduit and tubing for power systems shall be not less than 1-1/2 inches deep unless otherwise noted.

Pull Boxes:

Boxes shall be of not less than the minimum size required by the National Electrical Code and shall be furnished with screw fastened covers. When several feeders pass through a common pull box they shall be tagged to indicate clearly their electrical characteristics, circuit numbers and panel designations. Pull boxes cover plates larger than four square feet shall be provided with two handles.

Pull boxes shall be furnished and installed where necessary, as approved by the A/E, in the raceway system to facilitate conductor installation. Except as otherwise noted for telephone and data raceways, conduit runs longer than 200 feet, or with more than four 90 degree angle bends, shall have a pull box installed at a convenient intermediate location. Normally, when feeder routing is shown on drawings, pull boxes are not indicated. It is the responsibility of the electrical contractor to provide pull boxes as necessary to meet the stated requirements.

ACCESS DOORS IN FINISHED CONSTRUCTION:

Provide flush doors to access electrical boxes *as* specified and as permitted by Architect only.

Study architectural and electrical construction documents for areas with non-accessible finishes.

Where boxes and devices are to be concealed in walls or above non-removable ceilings, each Contractor shall provide the required access panels at no extra cost to the Owner.

Submit drawings to the Architect/Engineer showing location of proposed access doors prior to installation of any wiring. Architect/Engineer shall have the right to modify or delete location of access doors proposed by the electrical contractor without adding cost to the electrical contract.

Size of panels shall be larger than the devices for accessibility and shall not be less than 16"x 16" for all panels. Where the opening must allow adequate room for a person to pass through, a 24"x 24" panel shall be provided.

Construction of panels shall comply with the following:

Fire Rating: Access doors shall be constructed and installed in a manner that does not violate fire rating of ceiling or wall.

Regular Access Doors in Concrete or Masonry Walls: Shall be prime coated steel to the sizes and at the locations indicated. Locks shall be screwdriver operated.

Standard Thickness Plastered Walls: Shall be J.L. Industries Model PW, Karp Associates, Inc. Type DSC-214 PL, Milcor, Inc. Style "A", or approved equal.

Non-plastered walls: Shall be J.L. Industries Model TM, Karp Associated, Inc., Type DSB-214SM, Milcor Style "M", or approved equal.

Thin coat plastered walls: shall be J.L. Industries Model PW modified, Karp Associates, Inc. Type DSB-2I4 SM, Milcor style "DW" or approved equal.

Rated Access Doors in Concrete or Masonry Walls shall be prime coated steel to the sizes and at the locations indicated. Locks shall be key operated. Fire rating shall be for 1-1/2 hours in accordance with UL. Doors shall incorporate any modifications required to receive the wall finish. Shall be J.L. Industries Model FD, Karp Associates, Inc. Type KRP-150 FR, Milcor fire rated access door, or approved equal.

Regular Access Door in Plastered Ceiling: Shall have expanded mesh plastering lath on all 4 sides with method for securing to ceiling suspension system. Shall be Model PW by J.L. Industries, DSC- 214PL by Karp Associates, Inc., Style "K" by Milcor, or approved equal. Shall have screwdriver operated lock.

PART 3 EXECUTION:

INSTALLATION OF OUTLET BOXES:
Location of outlets shown on drawings, other than those dimensioned, are only approximate, the Owner shall have the right to make slight changes in the position of outlets if the Contractor is notified before roughing-in is done. The Contractor shall study the general building plans in relation to the spaces surrounding each outlet in order that his work may fit the other work required by these specifications. When necessary, the Contractor shall relocate outlets of junction boxes so that, when fixtures or other fittings are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Do not install outlets back to back.

Minimum length of conduit connecting to adjacent flush in wall outlets in sound rated walls shall be 18".

Boxes shall be installed in a rigid and satisfactory manner, either by wood screws on wood, expansion shields on masonry, or machine screws on steel work.

Recessed boxes in dry wall type construction shall be supported from both adjacent studs, or by the use of metal stud brackets as manufactured by E-Z Mount Bracket Co., or equivalent

Identify boxes in accordance with requirements of Section 26 0553.

INSTALLATION OF ABOVE THE CEILING OUTLET BOXES:

Outlet boxes shall be supported independently of conduit in accordance with NEC. Outlet boxes shall be installed at accessible locations. Do not use suspended ceiling grid to support

outlet boxes, but support from structure.

INSTALLATION OF PULLBOXES:

Pull boxes shall be installed overhead or on walls at locations free of interference with equipment, ducts, piping and activities being carried out at the premises.

BOXES AND CABINETS IN FIRE RATED WALLS:

Outlet boxes in one and two-hour fire rated walls shall be installed in conformance with approved UL methods. UL listed steel electrical outlets, switches, or junction boxes not exceeding 16 square inches in area and 2 3/16" in depth, in hollow walls or partition assemblies utilizing wood or metal studs or metal framing or channels are permitted, provided such openings do not exceed an average of 100 square inches per 100 square feet of wall and are staggered not less than 24 inches side-to-side horizontally when openings are provided on both sides of the assembly.

When location or dimension of outlet boxes does not meet the requirements listed above, protect each outlet utilizing gypsum board sheathing or fire proofing blankets in accordance with UL approved methods. One product approved to protect outlets is 3M Company moldable Putty Pads, Catalogue Number MPP-1.

Provide gypsum board covering all five sides of cabinets mounted in one or two hour fire rated walls to maintain rating of wall.

Do not install outlet boxes or cabinets in 4-hour rated walls.

END OF SECTION 26 05 41

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SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

SCOPE OF WORK

Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, receptacles, and other electrical equipment supplied for the project for identification of equipment, controlled, served, phase, voltage, etc. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws, and shall identify equipment controlled, attached, etc. Letters shall be approximately 1/2 inch high minimum. Embossed, self-adhesive plastic tape is not acceptable for marking equipment.

All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

NAMEPLATE INFORMATION:

Nameplate for panelboards and distribution switchboards shall indicate their designation plus circuit designation of panelboard feeder plus voltage. For example: "Panel 1DH - Served From”M-1,3,5”.

Nameplates for individual circuit breakers shall indicate equipment served circuit breaker frame and size in amperes of the breaker trip, plus circuit designation of power source.

Nameplates for individually mounted safety switches shall indicate designation of equipment served and circuit designation of power source. For example "Pump P-5 circuit 2MCB-A6".

Nameplates for troughs or wireways shall indicate given designation, voltage, phases and number of wires plus circuit designation of trough feeder.

Equipment likely to be energized from two different sources at the same time shall be provided with warning nameplates clearly stating this condition.

Each receptacle shall be provided with phenolic nameplate, or engraving, identifying circuit feeding receptacle. (For Example: "R-16").

PART 2 - PRODUCTS:

CONSTRUCTION:

Nameplates shall be 1/8 inch thick of phenolic material with all four face edges beveled 45 degrees, except that nameplates for wiring devices may be 1/16 inch thick of same type construction. Lettering shall be machine engraved to expose contrasting inner core color.

Lettering for sequence of operation signs, wiring devices and other lengthy explanatory signs, shall be not less than 1/8 inch high.

PART 3 - EXECUTION

GENERAL:

Affix nameplates to plates or equipment utilizing self-tapping stainless steel screws.

END OF SECTION 26 05 53

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

SCOPE OF WORK:

This section covers construction of all lighting and distribution panels and auxiliary panels as shown on the drawings.

Requirements of Section 26 0100 shall apply.

Refer to panelboard schedule and power riser diagram on drawings for specific requirements of each panel.

All panelboards shall be UL listed and labeled.

Service entrance equipment, including main distribution panelboard, shall be third party SE rated.

RELATED WORK SPECIFIED ELSEWHERE:

Section 26 0531 – Conduit
Section 26 0553 – Electrical Identification
Section 26 0574 – Arc Fault Hazard Identification
Section 26 0925 – Occupancy Sensor Lighting Control System

APPLICABLE STANDARDS:

| | |
|---|---|
| NEMA PB1 | Panelboards |
| UL 50 | Safety enclosures for electrical equipment |
| UL 67 | Panelboards |
| UL 489 | Molded—case circuit breakers, molded-case switches, and circuit breaker enclosures |
| UL 869A | Service equipment |
| UL 943 | Ground-fault circuit interrupters |

SUBMITTALS:

Detail shop drawings of panelboards provided under this Section shall be submitted for Architect/Engineer approval. Shop drawings shall show bus and circuit breaker arrangement as shown on Contract Drawings.

QUALITY ASSURANCE:

The contractor, through the manufacturer of the equipment specified here, shall review the use, details, and methods of installation of his product *as* indicated and shall disclose to the Architect *any* and all deviations from this recommended use and method of installation and shall also disclose to the Architect his recommendations for the use and method of installation of his product to achieve the intended purpose and result. Such disclosure shall be made within the time stipulated for submission of shop drawings.

PART 2 - PRODUCTS

MANUFACTURER:

All panelboards shall be the products of 1 manufacturer unless otherwise noted and shall be the standard products of Square D, Cutler Hammer or Siemens.

Equipment indicated and in the specification is based on the standard products of 1 manufacturer. The Contractor shall be responsible for the space requirements of other approved manufacturers.

WIRING TEMPERATURE RATING:

Products specified here, including all feeder and branch circuit protective devices shall be UL listed for connection to 75°C conductors, or higher_

BRANCH CIRCUIT PANELBOARDS:

Maximum quantity of circuit breakers in a branch circuit panelboard shall not exceed 42 poles.

Branch circuit panelboards shall be of the dead-front safety type. The panelboard shall be main circuit breaker type only. Panelboard shall be provided with the size and number of 1-pole, 2-pole or 3-pole branch circuits as indicated on the drawings, except when fused switches are specified for distribution type panelboards. Circuit breakers shall be of the automatic thermal magnetic type, quick-make and quick-break for manual and automatic operation. All multi-pole breakers shall be common trip. Each breaker shall be lockable. Each panelboard shall be provided with a grounding terminal busbar bonded to the cabinet or panelboard frame. Isolated ground bus shall additionally be provided when scheduled on drawings. All bus bars shall be copper.

All circuit breakers shall be bolt-on, calibrated for 40 degrees C. or be ambient compensating. Circuit breakers shall have UL interruption ratings as indicated on the drawings. Series rating for short circuit rating of panelboards and circuit breakers is not acceptable. Breakers used to switch lighting loads shall be labeled accordingly.

Each panel, as a complete unit, shall have a short circuit current carrying rating equal to or greater than the integrated equipment rating shown on the panel schedule or on the plans. This rating shall be established by testing with the over current devices mounted in the panel Method of testing shall be per UL standard 67. Panels shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed and bear the UL label.

Provide, when scheduled, ground-fault protection type branch circuit breakers (GFI) rated to trip when current leakage to ground exceeds 5 milliamperes.

Cabinets for branch circuit panelboards shall be minimum 20 inches wide, except otherwise noted for oversized gutters, and shall be provided with not less than 4-inch wiring gutters at the sides, top and bottom. Trim shall be hinged, door in door construction, and be secured closed with screws. Trims shall be fitted with hinged doors having combination lock and latch. All locks shall be keyed alike. One or more directory holders protected with clear plastic and metal frame as required for rendering entire directory visible shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit shall be mounted under plastic on inside of each door. Each circuit shall be identified by the type of load and the location of the load; I.E.: "Lighting Rooms 125, 127 and 128", which is not necessarily what, is shown on the contract drawings.

Unless otherwise specifically noted all circuit breakers in a panelboard shall have been built by the same manufacturer who built the panelboard.

Panelboards buswork including neutral and grounding busbars shall be copper. Neutral buses shall not be less than same rating of the panel, but shall be increased in size when so scheduled on drawings. Neutral and ground buses shall have sufficient wiring terminating positions to satisfy oversized feeder neutrals and dedicate branch circuit neutral conductors for each 277 or 120 volt circuits and grounding requirements for present and future breakers.

A running directory shall be maintained during construction.

All exterior and interior steel surfaces of panelboard trims shall be finished with gray ANSI-61 paint over a rust-inhibiting phosphatized primer.

Panelboards used as service equipment shall be UL labeled as "Suitable for use as Service Equipment."

Exterior panelboards shall be NEMA 4X rated and made of 304 Stainless Steel.

Panelboards shall have door-in-door feature (hinged front trim).

Panelboards shall be provided with mains as scheduled on drawings. If mains are not shown provide main circuit breaker matching the ampere rating of the panelboard.

Additional requirements for branch circuit panels:

A flush latch and tumbler type lock, so panel door may be held closed without being locked. All such locks shall be keyed alike. Furnish two keys with each lock, or a total of 10 keys for the project.

Cover shall have inside support studs to rest on lower edge of can while being fastened. For flush mounted panelboards, cover fastener hardware shall be concealed behind the hinged door.

Interior trim shall fit neatly between interior assemblies and cover leaving no gaps between the two. Where two section panels are specified, both panel trims shall have the same weight.

Breakers in branch circuit panels shall be physically arranged in locations shown in panel schedules on the drawings. They shall be connected to the phases as shown.

Additional Requirements for Labeling:

For branch circuit panels, directory cards shall be neatly typed to indicate load served by each breaker or fuse. Directory cards shall indicate circuits in a manner analogous to the physical circuit breaker arrangement (i.e. odd numbered circuits in one column, even numbered circuits in another). Mount cards behind heavy plastic shields in metal frame. Mark spares and spaces in erasable pencil only.

Next to each breaker within distribution panels, attach a label indicating load served. Wording shall be based on new floor plan room names, except updates per "as-built" conditions.

PART 3 - EXECUTION:

INSTALLATION:

Front edges of all flush mounted panel housing shall be exactly flush with the finished wall.

All equipment, either surface or flush mounted, shall be plumb and level.

All openings in boxes, cabinets, or gutters shall be cut or sawed with tools made for that purpose. Burning of openings is absolutely unacceptable.

All unused openings shall be closed.

Only one solid wire is allowable under a screw. Provide an approved lug for connecting stranded wire or more than one solid conductor.

MOUNTING HEIGHT:

Panelboards shall be mounted so that the operating handle of the top unit does not exceed 6' - 6". Panels mounted adjacent to each other shall have the top trim level.

SURFACE MOUNTED:

Exterior Walls: Panelboards on exterior walls shall be mounted on SS STRUT or similar type system, to provide minimum 1" air space between panel and wall.

Interior Walls: Panelboards shall be secured to wall in 4 locations using ACKERMAN-JOHNSON or similar fastening devices. Refer to specifications on supporting devices for additional requirements.

Panelboard trims shall be flush with enclosure.

All panelboard trims shall meet flush with wall when panel is flush mounted.

NAMEPLATE:

Provide nameplate in accordance with Section 26 05 53.

BRANCH CIRCUIT LABELING:

In accordance with requirements of the NCSCO, provide permanent identifying wire tags attached to each branch circuit conductor, including neutrals.

SPARE CONDUITS:

Provide for each flush-mounted panelboard six (6) spare 3/4 inch conduits from panel to above accessible ceiling of area served (normally a lab) for future extension cap conduits.

ADJUSTING AND CLEANING:

Adjust all operating mechanisms for free mechanical movement.

Touch up scratched or marred surfaces to match original finish.

Adjust trip and time delay settings of all adjustable circuit breaker trips as instructed by the Architect/Engineer. Contractor request in writing from the engineer the settings for the circuit breakers at least 90 days prior to the time scheduled to set the trip functions.

FLASH PROTECTION BOUNDARY:

The flash protection boundary and the incident energy for the electrical equipment shall be determined in accordance with IEEE 1584 NFPA 70E and NEC 110-16 requirements. Refer also to Owner General Standards for Electrical Installation attached to and made a part of overall specifications.

END OF SECTION 26 2416

SECTION 26 27 26 -WIRING DEVICES

PART 1 - GENERAL:

REFERENCE:

Wiring devices shall be as indicated and as specified below. All devices shall be UL listed and comply with NEMA WD-1.

PART NUMBERS:

Manufacturer's numbers listed are to establish a type and standard of quality. Any prefix and/or suffix, whether to be added or deleted to complete the number, shall be the Contractor's responsibility. This applies specifically but not exclusively to color identification, grade, and compliance with standards and specifications.

GRADE:

Industrial Specification Grade or Heavy Duty Grade devices shall be used.

COLOR:

Unless indicated otherwise, color of 20 ampere devices shall be:

| | |
|---|---|
| Standard Receptacle | Owner Selected |
| GFI Receptacle | Owner Selected |

Colors shall be that of the molding compound. Painting will not be acceptable.

WIRING:

Unless noted SWO (side wired only), devices shall be back and side wired screw type terminals. Pigtails will not be acceptable unless noted otherwise.

GROUNDING:

All devices shall be equipped with a "hex-head" green grounding screw for grounding the device to the grounding conductor run with the circuit conductors.

WIRING TEMPERATURE RATING:

Each wiring device shall be UL listed for use with 75 degree C rated wire or higher.

MANUFACTURER:

All devices shall be by a single manufacturer unless noted otherwise or not commercially available.

Furnish manufacturer's data and literature for each item provided under this Section.

SUBMITTALS:

Submit manufacturer's catalog information with proof of compliance with stated applicable standards.

SAMPLES:

Submit one non-returnable sample of each type receptacle and plate being installed in this building.

## PART 2- PRODUCTS

SWITCHES:

Switches shall comply with Federal Specification W-S-896 when commercially available.

Toggle switches shall be single pole, three-way, or four-way as indicated on the drawings. Switches shall be of the grounding type, with hex-head grounding screw, rated 20 A., 120/277 volt, AC only. Lighted handle switches shall have neon lights of the correct voltage rating where indicated on the drawings. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an "approved" third-party agency, approved for the voltage and amperage indicated.

| | Manufacturer | | |
|---|---|---|---|
| Device | HUBBELL | LEVITON | P&S |
| Toggle, 1-pole | 1221 | 1221 | 20AC1 |
| Toggle, 2-pole | 222 | 1222 | 20AC2 |
| Toggle, 3-way | 1223 | 1223 | 20AC3 |

RECEPTACLES:

Standard Receptacles:

Standard duplex receptacles shall be heavy duty, grounding type, with nylon body arranged for back and side wiring, with separate single or double grounding terminals. Standard receptacles shall be straight blade, NEMA configuration 5-20R, rated 20A., 125-volt and the face configuration shall conform to the NEMA Standards No. WD-1, NEMA WD-6, DSCC W-C-596G and UL-498, and shall be "approved" third-party listed. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system. Receptacles shall have a solid brass mounting strap with non-riveted, integral one-piece grounding system.

| | MANUFACTURER | | |
|---|---|---|---|
| Device | Hubbell | Arrow-Hart | P&S |
| Duplex, NEMA 5-20R<br>20A, 125V | * | * | * |
| Duplex, NEMA 5-20R<br>20A, 125V, Isolated Ground,<br>Surge Suppression W/<br>Light and Alarm<br>240 joules / 15KA | * | * | * |
| Duplex, NEMA 5-20R<br>20A, 125V, Isolated Ground | * | * | * |
| GFI duplex, 3-wire<br>Feed Through 20A-125V<br>NEMA5-20R | * | * | * |

* As required to comply with specification above.

PART 3- EXECUTION

ORIENTATION OF RECEPTACLES:

Receptacles shall be mounted vertically. Receptacles mounted over counters, back-splashes, etc., shall be mounted horizontally.

All vertically mounted receptacles shall be mounted with the grounding blade up.

All horizontally mounted receptacles shall be mounted with the grounding blade on the left, or up for GFI receptacles.

RECEPTACLE LABELING:

Each receptacle, whether mounted in wall or in multi-outlet assembly, shall have a permanent label indicating circuit and panel number. Refer to Section 26 0553 for requirements.

END OF SECTION 26 27 26

SECTION 26 2727 - COVER PLATES

PART 1 - GENERAL

GENERAL:

Provide cover plate on each outlet and on each wiring device.

Cover plates shall accommodate the devices installed in the outlet boxes. Where more than 1 device is indicated at the same location, a multiple ganged plate shall be used. Sectionalized plates shall not be acceptable. All cover plates shall be provided by the Contractor.

Plates shall be compatible with the device configuration.

Cover plates shall be UL listed and shall comply with Federal Specification W-P-455 and NEMA WD-1.

All cover plates over flush wall boxes shall meet flush with wall.

All cover plates shall be manufactured by a single manufacturer unless noted otherwise or not commercially available.

Furnish manufacturer's data and literature for each item provided under this Section.

PART 2 - PRODUCTS:

WIRING DEVICE PLATES:

Cover plates, for other than wiring devices on surface raceways, shall be 302 stainless steel, .040" thick, brushed finish, smooth surface. Owner shall have the option to change color and type. Cover plates for wiring devices that are part of surface raceways shall match raceway finish.

Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate, and shall be furnished with the plate by the plate manufacturer.

Manufacturer: Cover plate shall be manufactured by Hubbell, Sierra, P&S or Arrow-Hart unless noted otherwise.

END OF SECTION 26 27 27

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SECTION 26 28 13 – FUSES (600 VOLTS OR LESS)

PART 1 - GENERAL

SCOPE OF WORK:

The contractor shall provide fuses as indicated and as specified herein for over current protection of conductors and equipment rated 600 volts and lower.

SUBMITTALS:

Furnish manufacturer's catalog data for all products specified here.

WIRING TEMPERATURE RATING:

All products specified here shall be rated for connection to 75 deg. C wiring, or higher.

PART 2 - PRODUCTS:

FUSE DESIGN:

Fuses shall be UL listed and labeled.

All fuses shall have contact surfaces treated to maintain conductivity and tubing of dimensionally stable not degraded by extreme conditions of humidity and aridity. All fuses, unless otherwise noted, shall be dual-element, time-delay type.

Manufacturers: Buss, Shawmut, Littelfuse, G.E. or equal.

Provide fuses as follows:

| CIRCUIT TYPE | FUSE TYPE |
|---|---|
| Service entrance and feeder Class circuits 600A and less | RK1, UL listed, current limiting, time delay with 200K Amp interrupting rating, except use Class J, dual element time-delay for fuses in "high density fusible switchboards" |
| Motor, motor controller and transformer circuits | Class RK1, UL listed, current limiting time delay, w/200k Amp interrupting rating. |

PART 3 - EXECUTION

Provide fuse removal tool.

Fuses shall be of the proper voltage class corresponding to the distribution system in which it is used.

Fuses shall not be shipped in equipment but shall be installed prior to energizing equipment.

The fuse type and rating marked on fuse barrels shall be totally visible when installed.

All fuses installed in each fusible switch shall be of the same manufacturer size and type.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

SCOPE OF WORK:

Requirements of Sections 26 01 00 and 26 05 53 shall apply.

Work included shall include but not necessarily be limited to the following:

. Fusible safety and disconnect switches
. Non-fusible safety and disconnect switches
. Molded Case Circuit Breakers (MCCBS)
. Enclosures

APPLICABLE STANDARDS

NEMA KS-1 Enclosed and miscellaneous distribution equipment switches (600 volts maximum)

UL 98 Enclosed and dead-front switches

SUBMITTALS:

Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated.

Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details and attachments to other work.

Wiring Diagrams: For power, signal and control wiring.

INFORMATION SUBMITTALS

Field quality control reports.

CLOSEOUT SUBMITTALS

Operation and Maintenance Data

QUALITY ASSURANCE

Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with NFPA 70.

PART 2 - PRODUCTS:

MANUFACTURER:

All products shall be from 1 manufacturer unless otherwise noted and shall be the standard products of Square D, Cutler Hammer or Siemens.

WIRING TEMPERATURE RATING:

Products specified here shall be UL listed for connection to 75-degree C conductors, or higher, and third party listed.

SAFETY DISCONNECT SWITCHES:

Provide fusible and/or non-fusible heavy duty safety and disconnect switches with ratings and fuse types and sizes as shown on the drawings. Provide horsepower rated switches for use as motor circuit disconnecting means, in accordance with the individual manufacturer's published ratings. For applications in excess of switch ratings provide non-automatic molded cast circuit breakers rated not less than 125% of motor full load current. Provide each fused switch with the following:

. NEMA 4X , 304 SS Enclosure
. Line terminal shields
. Visible copper blades
. ATC chute for each pole
. Non-fusible, positive, quick-make, quick-break interrupter operating mechanism.
. Rejection fuse clips sized for specified fuses. Contractor shall provide fuse reducer if so required.
. Handle whose position is easily recognizable in the 'on' or 'off position and can be multiple padlocked in the "OFF" position.
. Defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.
. Factory installed ground lug.
. 'R.' type fuse holders — furnish switches completely fused
. Provide padlocks provisions

SWITCH ACCESSORIES:

Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

Neutral Kit: Internally mounted, insulated, capable of being grounded and bonded, labeled for copper and aluminum neutral conductors.

Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

Lugs: Suitable for number, size and conductor material.

Service Rated Switches: Labeled for use as service equipment.

PART 3 - EXECUTION

INSTALLATION OF WORKMANSHIP:

Enclosure: Mount switch enclosure rigidly and with proper alignment.

Switches shall not be mounted in an inaccessible location or where passageway to the switch may become obstructed.

Wiring: Install all incoming and outgoing power circuits.

Fuses: Install fuses, where required, of the proper type and ratings as shown on the drawings.

Locate disconnect switches as close as possible to the equipment being protected, at accessible location.

Provide nameplate identifying equipment served and circuit serving equipment. Refer to Section 26 05 53.

END OF SECTION 26 28 16

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SECTION 26 32 13 – Diesel Driven Generator

## PART 1 GENERAL

### 1.1 SUMMARY

A This section includes the following items from a single supplier:
   1. Engine Generator Set.
   2. Enclosure
   3. Related Accessories as specified

B Products Furnished or Supplied but not installed

C Products Installed but not furnished or supplied

D Related Requirements
   1. It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
   2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been are omitted or have been taken exception to, and a complete description of all deviations.
   3. It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
   4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

## 1.2 SUBMITTALS

A Action Submittals
1. Product Data
a The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

B Informational Submittal
1. Certificates
a The generator set shall be listed to UL 2200 or submitted to an independent third party certification process to verify compliance as installed.
b The generator set shall be IBC Certified as meeting the required maximum seismic design acceleration level per the International Building Code 2000/2003 or 2006 for the specific job site. The generator shall be analyzed or shake tested by a third party, accompanied by a Certificate of Compliance, and include a seismic label on the generator set (per Section 1702 of the IBC Code). Seismic certified generators shall be installed per the specific seismic instructions provided by the manufacturer.

## 1.3 Quality Assurance

A Regulatory Agency
1. The generator set shall conform to the requirements of the following codes and standards:
a CSA C22.2, No. 14-M91 Industrial Control Equipment.
b EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.
c EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
d IEC8528 part 4, Control Systems for Generator Sets.
e IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.
f IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
g NFPA 70, National Electrical Code, Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
h NFPA 99, Essential Electrical Systems for Health Care Facilities.
i NFPA 110, Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required

by this standard shall have been performed on a complete and functional unit. Component level type tests will not substitute for this requirement.

2. Qualifications
   a The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
   b The power system shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.

3. Manufacturers
   a The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

## 1.4 Field or Site Conditions

A Ambient Conditions
1. Engine- generator set shall operate in the following conditions without any damage to the unit or its loads.
   a Ambient Temperature: 105 °F
   b Altitude : 500 ft
   c Relative Humidity: 95%

## 1.5 Warranty or Bond

A Manufacturer's Warranty
1. The generator set shall include a standard warranty covering two (2) years or 2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.
2. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions;

adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

B **PART 2 PRODUCTS**

## 2.1 Equipment

A Equipment

1. The basis of design is Kohler model 1600REOZMD with a 7M4050 alternator. It shall provide 1,875.00 kVA and 1,500.00 kW when operating at 277/480 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby rating while operating in an ambient condition of less than or equal to 105 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage. Acceptable manufacturers are Kohler, Cummins and Caterpillar.

B Engine

1. The minimum 65.4 liter displacement engine shall deliver a minimum of 2346 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:
   a. Electronic isochronous governor capable of 0.25% steady-state frequency regulation
   b. Dual 24-volt positive-engagement solenoid shift-starting motors
   c. 30-ampere automatic battery charging alternator with a solid-state voltage regulation
   d. Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
   e. Dry-type replaceable air cleaner elements for normal applications
   f. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel
   g. The turbocharged engine shall be fueled by diesel
   h. The engine shall have a minimum of 16 cylinders and be liquid-cooled
2. The engine shall be EPA certified from the factory
3. The generator must accept rated load in one-step.

C Cooling System

1. The engine shall be liquid-cooled by a closed loop, unit mounted radiator rated to operate the generator set at full load at an ambient temperature of 50 degrees

C (122 degrees F). The radiator fan and other rotating engine parts shall be guarded against accidental contact.

D Standard Air Cleaner

1. The air cleaner shall provide engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

E Battery

1. Each genset requires a quantity of four BCI group 8D batteries which must meet the engine manufactures' specifications for the ambient conditions specified in Part 1 Project Conditions and shall comply with the NFPA requirements for engine cranking cycles. Each battery shall be rated according to SAE Standards J-537 with a minimum cold cranking amp of 1150 amps and a minimum reserve capacity of 430 Minutes at 80F. The battery must contain two handles to aid in lifting and the case must be constructed of polypropylene to resist breakage and extend service life. Removable cell covers shall be provided to allow for checking of electrolyte specific gravity.
2. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

F Housing

1. Weather Enclosure
   a The generator set enclosure shall be a factory assembled package constructed from a minimum of 0.080 inch thick formed heavy duty aluminum panels. The enclosure shall have a radiator fill panel to provide easy service access to the radiator. The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement.
   b The enclosure shall be painted with a fade-, scratch- and corrosion resistant polyurethane enamel that is wet sprayed and has an automotive quality finish.
   c The enclosure must surpass a 3,000 hour salt spray corrosion test per ASTM B-1117.
   d Enclosures will be finished in the manufacturer's standard color.
   e The enclosures shall allow the generator set to operate at full load in an ambient temperature of 40 - 50°C with no additional derating of the electrical output of the generator set.
   f Enclosures shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker shall meet the requirements of the National Electric Code.

g Doors shall be hinged with stainless steel lift off hinges, and hardware, and the doors shall be removable. Access doors shall be rubber sealed to prevent water intrusion and to minimize noise.

h Doors shall be equipped with lockable latches. Locks shall be keyed alike. Door locks shall be recessed to minimize potential of damage to door/enclosure.

i A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.

j The complete exhaust system shall be internal to the enclosure.

k The critical silencer shall be fitted with a tailpipe and rain cap.

G Fuel oil storage

1. Double Wall Secondary Containment Sub-base Fuel Tank

a The generator set shall be supplied with a sub-base fuel tank of sufficient capacity to hold 6200 gallons (48 Hour Runtime) of diesel fuel.

b The sub-base fuel system shall be listed under UL 142, subsection entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification.

c The above ground steel secondary containment rectangular tank for use as a sub base for diesel generators is manufactured and intended to be installed in accordance with the Flammable and Combustible Liquids Code—NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines—NFPA 37, and Emergency and Standby Power Systems—NFPA 110.

d The primary tank shall be rectangular in shape and constructed in clam shell fashion to ensure maximum structural integrity and allow the use of a full throat fillet weld.

e Steel Channel Support System. Reinforced steel box channel for generator support, with a load rating of 5,000 lbs. per generator mounting hole location. Full height gussets at either end of channel and at generator mounting holes shall be utilized.

f Exterior Finish. The sub-base tank exterior finish shall be Power Armor Plus™, a polyurea-textured rubberized coating.

g Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter.

h The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated on the basis of 100 percent of the primary tank. The vent is to be spring-pressure operated: opening pressure is 0.5/psig and full opening pressure is 2.5 psig. The emergency relief vent is to be sized to accommodate the total venting capacity of both normal and emergency vents.

i There shall be a 2" NPT opening within the primary tank and lockable manual fill cap.
j A direct reading, UL listed, magnetic fuel level gauge with a hermetically sealed, vacuum tested dial, to eliminate fogging, shall be provided.
k A float switch for remote or local annunciation of a (50% standard) low fuel level condition shall be supplied.

H Controller

1. Decision-Maker® 550 Controller (Basis of design)
   a. The generator set controller shall be a microprocessor based control system that will provide automatic starting, system monitoring, and protection. The controller system shall also provide local monitoring and remote monitoring. The control system shall be capable of PC based updating of all necessary parameters, firmware, and software. .
   b. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.

2. Codes and Standards
   a. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
   b. The controller shall meet NFPA 99 and NEC requirements.
   c. The controller shall be UL 508 listed.

3. Applicability
   a. The controller shall be a standard offering in the manufacturer's controller product line.
   b. The controller shall support 12-volt and 24volt starting systems.
   c. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
   d. The controller shall mount on the generator or remotely within 40 feet with viewable access.

4. Hardware Requirements
   a. Control Panel shall include:
      1. The control shall have a run-off/reset-auto three-position selector switch
      2. Emergency Stop Switch. The controller mounted, latch type remote stop switch shall be red in color with a "mushroom" type head. Depressing the stop button will immediately stop the generator set and lockout the

generator set for any automatic remote starting.

3. Five indicating lights (LED):
   a. System Ready - green
   b. Not in Auto - yellow
   c. Programming Mode - yellow
   d. System Warning – yellow
   e. System Shutdown – red
4. Digital Display. The digital display shall be a vacuum fluorescent display with two lines of alphanumeric, with 2 lines of data and 20 characters. The display shall be viewable in all light conditions. The display shall display status of all faults and warnings. The display shall also display any engine faults. The 16-button keypad gives the user information access and local programming capability.
5. Sixteen-position snap action environmentally sealed tactile-feel membrane keypad for menu selection and data entry.
6. For ease of use, an operating guide shall be printed on the controller faceplate.
7. Alarm Horn. The controller shall provide an alarm horn that sounds when any faults or warnings are present. The horn shall also sound when the controller is not in the AUTO mode.
8. Lamp Test Button. When this button is depressed, it shall test all controller lamps.
9. Alarm Off. This button will silence the alarm horn when the unit is AUTO.
10. Panel lights shall be supplied as standard.

5. Control Functional Requirements
   a. The generator controller shall display and monitor the following engine and alternator functions and allow adjustments of certain parameters at the controller:
      1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
      2. Field-programmable time delay engine cool down. Adjustment range 0-10 minutes in 1 second increments.
      3. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
      4. The idle function including engine cooldown at idle speed.
      5. Real-time clock and calendar for time stamping of events.
      6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds

7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
8. Programmable cyclic cranking that provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles.
9. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.
10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
11. Control logic with RMS digital voltage regulation. The system shall have integral microprocessor based voltage regulator system that provides +/- 0.25% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum +/- 20% adjustable of nominal voltage.
12. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.
13. Alternator thermal overload protection. The system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.
14. Control function shall include output voltage adjustment.
15. Battle switch function selection to override normal fault shutdowns, except emergency stop and over speed shutdowns.
16. The control shall detect the following conditions and display on control panel:
    a. Customer programmed digital auxiliary input ON (any of the 21 inputs available)
    b. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines)
    c. Emergency stop

d. High coolant temperature
e. High oil temperature
f. Controller internal fault
g. Locked rotor - fail to rotate
h. Low coolant level
i. Low oil pressure
j. Master switch error
k. NFPA common alarm
l. Overcrank
m. Overspeed with user-adjustable level, range 60-70 Hz.
n. Overvoltage with user adjustable level, range 105% to 135%
o. Overfrequency with user adjustable level, range 102% to 140%
p. Underfrequency with user adjustable level, range 80% to 90%
q. Undervoltage with user adjustable level, range 70% to 95%
r. Coolant temperature signal loss
s. Oil pressure gauge signal loss

17. Conditions resulting in generator warning (generator will continue to operate):
    a. Battery charger failure
    b. Customer programmed digital auxiliary input on (any of the 21 inputs available)
    c. Customer programmed analog auxiliary input on (any of the 7 inputs available on ECM engines and 5 inputs for non ECM engines)
    d. Power system supplying load
    e. Ground fault detected - detection by others
    f. High battery voltage - Level shall be user adjustable. (Range 29-33 volts for 24-volt systems.)
    g. High coolant temperature
    h. Load shed
    i. Loss of AC sensing
    j. Underfrequency
    k. Low battery voltage - level shall be user adjustable (Range 20-25 volts for 24-volt systems.)
    l. Low coolant temperature
    m. Low fuel level or pressure
    n. Low oil pressure
    o. NFPA common alarms

p. Overcurrent
q. Speed sensor fault
r. Weak battery
s. Alternator protection activated

6. Control Monitoring Requirements
   a. The generator set shall have alarms and status indication lamps that show non-automatic status and warning and shutdown conditions. The controller shall indicate with a warning lamp and or alarm and on the digital display screen any shutdown, warning or engine fault condition that exists in the generator set system. The following alarms and shutdowns shall exist as a minimum:
      1. All monitored functions must be viewable on the control panel display.
      2. The following generator set functions shall be monitored:
         a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy
         b. All single phase and three phase currents, 0.25% accuracy
         c. Output frequency, 0.25% accuracy
         d. Power factor by phase with leading/lagging indication
         e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy
         f. kVARS total and per phase, 0.5% accuracy
         g. kVA total and per phase, 0.5% accuracy
         h. kW hours
         i. A display of percent generator set duty level (actual kW loading divided by the kW rating)

      3. Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
         a. Coolant temperature both in English and metric units
         b. Oil pressure in English and metric units
         c. Battery voltage
         d. RPM
         e. Lube oil temperature*
         f. Lube oil level*
         g. Crankcase pressure*
         h. Coolant level*
         i. Coolant pressure*
         j. Fuel pressure*
         k. Fuel temperature*

l. Fuel rate*
m. Fuel used during the last run*
n. Ambient temperature*

4. Operational records shall be stored in the control beginning at system startup.
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Number of starts
   e. Factory test date
   f. Last run data including date, duration, and whether loaded or unloaded
   g. Run time kilowatt hours

5. The following operational records shall be a resettable for maintenance purposes:
   a. Run time hours
   b. Run time loaded hours
   c. Run time unloaded hours
   d. Run time kilowatt hours
   e. Days of operation
   f. Number of starts
   g. Start date after reset
6. The controller shall store the last one hundred generator set system events with date and time of the event.

7. For maintenance and service purposes, the controller shall store and display on demand the following information:
   a. Manufacturer's model and serial number
   b. Battery voltage
   c. Generator set kilowatt rating
   d. Rated current
   e. System voltage
   f. System frequency
   g. Number of phases

7. Inputs and Outputs
   a. Inputs
      1. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
      2. There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for

monitoring and control.

3. Each analog input can accept 0-5 volt analog signals
4. Resolution shall be 1:10,000
5. Each input shall include range settings for 2 warnings and 2 s hutdowns.
6. All values shall be on the control panel display.
7. Shall be user-assigned.
8. Additional standard inputs required:
    a. Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
    b. Reset of system faults.
    c. Remote two-wire start.
    d. Remote emergency stop.
9. Idle mode enable.

b. Outputs

1. All NFPA 110 Level 1 outputs shall be available.
2. Thirty outputs shall be available for interfacing to other equipment
    a. All outputs shall be user-configurable from a list of 25 functions and faults
    b. These outputs shall drive optional dry contacts.
3. A programmable user-defined common fault output with over 40 selections shall be available.

8. Communications (Modbus protocol)
    a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
    b. Industry standard Modbus communication shall be available.
    c. A Modbus master shall able to monitor and alter parameters, and start or stop a generator.
    d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows XP, or Windows 7 or later.
    e. Communications shall be available for serial, CAN, and Ethernet bus networks.
    f. A variety of connections shall be available based on requirements:
        1. A single control connection to a PC.
        2. Multiple controls on an intranet network connected to a PC.
        3. A single control connection to a PC via phone line.
        4. Multiple controls to a PC via phone line.
    g. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same

communication network.

h. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
i. Cabling shall not be limited to the controller location.
j. Network shall be self-powered.

9. Communications (RBUS protocol)
   a. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
   b. Kohler proprietary RBUS communication shall be available.
   c. A RBUS shall be able to monitor and alter parameters, and start or stop a generator.
   d. The controller shall have the capability to communicate to a personal computer (IBM or compatible) and appropriate application software.
   e. A variety of connections shall be available based on requirements:
      1. A single control connection to a PC via USB
      2. Internet connection via Ethernet
   f. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.

I Generator Overcurrent and Fault Protection

1. The generator shall be provided with a factory installed, 100% rated line circuit breaker rated at 2,500.00 amperes that is UL489 listed. Line circuit breakers shall be sized for the rated ampacity of the loads served by the breaker per the NEC.
2. The circuit breaker(s) shall incorporate an electronic trip device with the following characteristics:
3. Adjustable long time delay
4. Adjustable short time delay *[As applicable]*
5. Instantaneous
6. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.
7. The shunt trip device shall be connected to trip the generator breaker when the generator-set is shut down by other protective devices.
8. When GFI is required per the NEC, additional neutrals shall be factory installed, and the alarm indication shall be integrated with the generator-set alarms.

9. Barriers to provide segregation of wiring from an emergency source to emergency loads from all other wiring and equipment, if required by the NEC, shall be provided.

J Alternator

1. The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a maintenance-free bearing, designed for 40000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.
4. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 4,500.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

K Vibration Isolation

1. Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

## 2.2 Accessories

A. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

B. The generator set shall be supplied with a 10-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:
   i. Automatic 3-stage float to equalization charge
   ii. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
   iii. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
   iv. LED lamp for power ON indication
   v. Current limited during engine cranking, short circuit, and reverse polarity conditions
   vi. Temperature compensated for ambient temperatures for -40°C to 60°C
   vii. UL 1012 Listed
   viii. CSA Certified

C. Remote annunciator panel – The remote annunciator shall meet NFPA 110, Level 1 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Options shall be available to provide ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements. The annunciator shall be located in the Main Office Building at location specified by owner.

## 2.3 Source Quality Control

A. Non-Conforming Work

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

a. **Design Prototype Tests.** Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
   i. Maximum power (kW)
   ii. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
   iii. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
   iv. Governor speed regulation under steady-state and transient

conditions.

v. Voltage regulation and generator transient response.
vi. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
vii. Three-phase short circuit tests.
viii. Alternator cooling air flow.
ix. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
x. Endurance testing.

b. **Final Production Tests.** Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:
   i. Single-step load pickup
   ii. Safety shutdown device testing
   iii. Rated Power @ 0.8 PF
   iv. Maximum power
   v. Upon request, a witness test, or a certified test record sent prior to shipment.

c. **Site Tests.** The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
   i. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
   ii. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.
   iii. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
   iv. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.

END OF SECTION 26 32 13

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SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SUMMARY

A This section includes the following items from a single supplier:
1. Automatic transfer switch
2. Related Accessories as specified

B Related Requirements
1. It is the intent of this specification to secure an automatic transfer switch that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.
2. Any exceptions to the published specifications shall be subject to the approval of the engineer and submitted minimum 10 days prior to the closing of the bid with a line by line summary description of all the items of compliance, any items that have been are omitted or have been taken exception to, and a complete description of all deviations.
3. It is the intent of this specification to secure an automatic transfer switch that has been tested during design verification, in production, and at the final job site. The automatic transfer switch will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the National Electrical Code and applicable local codes and regulations.
4. All equipment shall be new and of current production by an international, power system manufacturer of generators, transfer switches, and paralleling switchgear. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

1.2 SUBMITTALS

A Action Submittals

1. Product Data

a The submittal shall include specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

1.3 Quality Assurance

A Regulatory Agency

1. The automatic transfer switch shall conform to the requirements of the following codes and standards:

a UL 1008 - Standard for Transfer Switch Equipment

b IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching EquipmentEN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

c NFPA 70 - National Electrical Code

d NFPA 99 - Essential Electrical Systems for Health Care Facilities

e NFPA 110 - Emergency and Standby Power Systems

f IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

g NEMA Standard ICS 10-2005, Electromechanical AC Transfer Switch Equipment.

h EN61000-4-4 Fast Transient Immunity Severity Level 4

i EN61000-4-5 Surge Immunity Class 4 (voltage sensing and programmable inputs only)

j IEEE 472 (ANSI C37.90A) Ring Wave Test

k IEC Specifications for EMI/EMC Immunity (CISPR 11, IEC 1000-4-2, IEC 1000-4-3, IEC 1000-4-4, IEC 1000-4-5, IEC 1000-4-6, IEC 1000-4-8, IEC 1000-4-11)

l CSA C22.2 No. 178 certification

2. Qualifications
   a The automatic transfer switch shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.
   b A manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year shall produce the automatic transfer switch.
3. Manufacturers
   a The automatic transfer switch shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.
   b The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The Service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
   c The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

1.4 Field or Site Conditions

A Ambient Conditions

1. Automatic transfer switch shall operate in the following conditions without any damage to the unit or its loads.
   a Ambient Temperature: -4 to 158 Degrees F
   b Relative Humidity: 5% to 95% noncondensing

PART 2 PRODUCTS

2.1 Owner-Furnished or Owner-Supplied

A New Products

B Existing Products

2.2 Equipment

A Equipment

1. Furnish and install an automatic transfer switches system(s) with 4-Pole / 4-Wire, Switched Neutral, 2600 Amps, 480V/60Hz. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B Manufacturer

1. The Basis of Design is Kohler Any Breaker Rated - Programmed Transition (KCP)/KCP-AMVA-2600S. Acceptable manufacturers are Kohler, Cummins and Caterpillar.

C Enclosure

2. The ATS shall be furnished in a NEMA 1 enclosure.
3. All standard door mounted switches and indicating LEDs shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

A Controls

1. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and control through the communications interface port or USB. The following parameters shall only be adjustable via a password protected programming on the controller:
   a Nominal line voltage and frequency
   b Single or three phase sensing
   c Operating parameter protection
   d Transfer operating mode configuration (Standard transition, Programmed transition, or Closed transition)

B Voltage and Frequency

1. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored. Voltage on both normal and emergency sources and frequency on the emergency sources shall be adjustable with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

| | Parameter | Dropout/Trip | Pickup/Reset |
|---|---|---|---|
| a | Parameter | Dropout/Trip | Pickup/Reset |
| b | Under voltage | 75 to 98% | 85 to 100% |
| c | Over voltage | 06 to 135% | 95 to 100% of trip |
| d | Under frequency | 95 to 99% | 80 to 95% |
| e | Over frequency | 01 to 115% | 105 to 120% |
| f | Voltage unbalance | 5 to 20% | 3 to 18% |

2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.
3. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.
4. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad, remotely via the communications interface port or USB.
5. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through the communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being disabled, if required.
6. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition is a loss of phase and shall be considered a failed source.
7. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

C Additional Features

1. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.
2. The display shall provide for the test functions, allowed through password security. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.
3. A contact closure shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
4. Auxiliary contacts shall be provided consisting of a minimum of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
5. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
6. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency

sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.

7. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.
8. Provide the ability to select “commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
9. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad, communications interface port or USB. A “not-in-auto" LED shall indicate anytime the controller is inhibiting transfer from occurring.
10. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled from the user interface, communications interface port or USB.
11. The programmed transition feature shall control the transfer so that mechanism is placed in a load disconnect position for an adjustable period of time, giving motor and transformer loads an opportunity to decay to acceptable levels. The programmed transition feature shall be specifically designed for and be the product of the ATS manufacturer. The programmed transition setting shall be capable of being enabled or disabled from the user interface, communications interface port or USB. The controller shall include a built-in time delay for programmed transition operation. This time shall be adjustable from the user interface. The default value shall be 1 second and shall be adjustable from 0 to 60 minutes.
12. A time based load control feature shall be available to allow the prioritized addition and removal of loads based during transfer. This feature may be enabled for either or both sources. The user shall be able to control up to nine loads with independent timing sequences for pre and post transfer delays in either direction of transfer.
13. The controller shall provide 2 inputs for external controls that can be programmed from the following values:
    a Common fault, Remote test, Inhibit transfer, Low battery voltage, Peak shave, Time delay bypass, Load shed forced to OFF position (Programmed transition only)
14. The controller shall provide two form "C" contact outputs rated for up to 12A @ 240VAC or 2A @ 480VAC that can be programmed from the following values:
    a Aux switch open, Transfer switch aux contact fault, Alarm silenced, Alarm active, I/O communication loss, Contactor position, Exercise active, Test mode active, Fail to transfer, Fail to acquire standby source, Source available, Phase

rotation error, Not in automatic mode, Common alarm. In phase monitor sync, Load bank control active, Load control active, Maintenance mode active, Non-emergency transfer, Fail to open/close, Loss of phase, Over/under voltage, Over/under frequency, Voltage unbalance, Start signal, Peak shave active, Preferred source supplying load, Standby source supplying load

15. The controller shall be capable of expanding the number of inputs and outputs with additional modules.
16. Optional input/output modules shall be furnished which mount on the inside of the enclosure to facilitate ease of connections.
17. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
    a Enable or disable the routine
    b Enable or disable transfer of the load during routine.
    c Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every)
    d Set the duration of the run.
    e At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be display when the exercise is active. It shall be possible of ending the exercise event with a single button push.
18. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.
19. System Status - The controller shall have a default display the following on:
    a System status
    b Date, time and type of the next exercise event
    c Average voltage of the preferred and standby sources
    d Scrolling through the displays shall indicate the following:
        i) Line to line and line to neutral voltages for both sources
        ii) Frequency of each source
        iii) Load current for each phase
        iv) Single or three phase operation
        v) Type of transition
        vi) Preferred source
        vii) Commit or no commit modes of operation
        viii) Source/source mode
        ix) In phase monitor enable/disable
        x) Phase rotation
        xi) Date and time

20. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
21. Self-Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
22. Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration). This module shall allow for seamless integration of existing or new communication transfer devices and generators.
23. The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.
24. The controller shall contain a USB port for use with a software diagnostic application available to factory authorized personnel for downloading the controller's parameters and settings; exercise event schedules; maintenance records and event history. The application can also adjust parameters on the controller.
25. Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be accessible via the communications interface port or USB.
    a Event Logging
        i) Data, date and time indication of any event
    b Statistical Data
        i) Total number of transfers*
        ii) Total number of fail to transfers*
        iii) Total number of transfers due to preferred source failure*
        iv) Total number of minutes of operation*
        v) Total number of minutes in the standby source*
        vi) Total number of minutes not in the preferred source*
        vii) Normal to emergency transfer time
        viii) Emergency to normal transfer time
        ix) System start date
        x) Last maintenance date
        xi) * The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.
26. External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door

mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

2.3 Accessories

A. Standard I/O Module. The standard I/O Module shall have two programmable inputs and six programmable outputs.

i. Inputs Available 2

1. Contact Closure
2. Current 5mA Max.
3. Connection Type Terminal Strip
4. Wire Size #14-24 AWG
5. Max Distance 700 feet

ii. Outputs Available 6

1. Contact Type Form C (SPDT)
2. Contact Rating 2A @ 30VDC, 500mA @ 125VAC
3. Connection Type Terminal Strip
4. Wire Size #14-24

2.4 Source Quality Control

A Test and Inspection

1. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
2. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

END OF SECTION 26 36 23

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SECTION 26 45 00
SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

A. The Drawings and provisions of the General Conditions, Special Conditions, and the Sections included under General Requirements are included as part of this Section as though bound herein.

### 1.2 WORK INCLUDED

A. This section gives the requirements for SCADA system work for phase 3 on the Lincoln County Killian Creek SCADA System.

B. Completeness: These specifications cover the intended function of the equipment, but do not necessarily cover all details necessary for a complete, operating and functional system. Contractor shall supply all devices and appurtenances necessary to provide a complete, operable and satisfactory system as indicated or specified.

### 1.3 ABBREVIATIONS

| | |
|---|---|
| AI | Analog Input |
| AO | Analog Output |
| DI | Digital Input |
| DO | Digital Output |
| I/O | Input/output |
| RTU | Remote Terminal Unit |
| SBR | Sequenced Batch Reactor |
| SCADA | Supervisory Control and Data Acquisition |
| UI | Universal Input |

### 1.4 SUBMITTALS

A. Pre-Construction: Shop drawings and product data for component installation to upgrade the existing RTUs to accommodate the additional I/O required for this project.

B. Post-Construction: Submit to the Owner, CD copies of software for the SCADA system. One copy of the software shall be of the base software control system. Two copies shall be provided with all programmed variables, parameters, and functions of the SCADA system.

### 1.5 CERTIFICATIONS

A. Equipment and components shall be 3rd. part listed; UL, ETL, CSA, etc.

### 1.6 WARRANTY / GUARANTEE

A. The Integrator shall provide a 1-year warranty for all installed equipment stating that it is free from defects in workmanship and material.

B. It is the intent of these specifications that the integrator shall furnish a complete, integrated, functionally operating system. Integrator shall warrant that the system performs the intended functions.

PART 2 PRODUCTS

2.1 SCADA SYSTEM COMPONENTS

A. The components of Lincoln County's existing SCADA System at Killian Creek Wastewater Treatment Plant include seven RTUs designated SCADA Base RTU, RTU1&1A, RTU2&2A, and RTU3&3A.

B. The existing remote terminal units (RTU) utilize the following components for inputs and outputs.

1. Dorsett MicroScan4 Universal Controllers Part No. MS4-UNV.
2. Dorsett MicroScan4 Digital Controllers Part No. MS4-DIG.
3. Dorsett MicroScan5 Digital Controllers Part No. MS5-UNV.

C. The Owner's integrator for SCADA system work is:

Dorsett Technologies, Inc.
100 Woodlyn Drive
Yadkinville, NC 27055
Phone: 336-518-1300
Fax: 336-679-8811
Contact: David W. Hutchens

D. Replacement or upgrades to RTUs required to accommodate additional I/O for this project shall be determined by the Owner's SCADA integrator. Components not requiring replacement shall be re-used with the existing RTUs.

E. Modifications shall be compatible with and interface seamlessly with the existing Lincoln County SCADA System.

2.2 RTU MODIFICATIONS

A. Modifications for RTUs are quantified below based on information available for existing and proposed I/O quantities. Existing I/O availability shall be verified in the field. Proposed I/O shall be verified with what is indicated in the project drawings.

B. SCADA BASE RTU (Lab Building):

1. No additional hardwired I/O connections are anticipated to this RTU.
2. This RTU is connected via a digital communications link to the plant SBR Control Panel to monitor status of the SBR system equipment and components. SCADA programming will be required for modifications to the SBR system as part of this upgrade project.
3. Control system programming shall be performed to provide system monitoring and control functions and modifications. Specific revisions to be incorporated associated with the SBR system are indicated on Instrumentation and Control Schedules in the project drawings. All communication with the SBR system will with Modbus TCP with mapping and
Registers and protocol converter supplied by the SBR provider.

C. RTU1 & 1A (Blower Building):

1. Record documents show the following I/O availability:
   a. DI: 20.
   b. DO: 29.
   c. UI: 20.
   d. AO: 32.
2. This plant expansion project requires the following I/O points:
   a. DI: 16.
   b. AI: 5.
3. To accommodate the additional inputs, it is anticipated that installation of an expansion cabinet associated with the RTU is necessary.

D. RTU2 & 2 A (Dewatering Building):

1. Record documents show the following I/O availability:
   a. DI:
   18. b. DO:
   78. c. UI:
   45. d. AO:
   24.
2. This plant expansion project requires the following I/O points:
   a. DI: 0.
   b. DO: 0.
3. To accommodate the additional inputs, it is anticipated that installation of an expansion cabinet or multiple expansion cabinets associated with the RTU is necessary.

E. RTU3 & 3 A (Filter / UV Building):

1. Record documents show the following I/O availability:
   a. DI: 32.
   b. DO: 93.
   c. UI: 29.
   d. AO: 31.
2. This plant expansion project requires the following I/O points:
   a. DI: 32.
   b. AI: 41.
   c. UI 23.
3. To accommodate the additional inputs, it is anticipated that installation of an expansion cabinet or multiple expansion cabinets associated with the RTU is necessary.
4. Modifications to the existing UV system have been made to eliminate hardwired monitoring of the UV system via SCADA RTU3. Modifications include the addition of a Modbus TCP communications link between the UV system and SCADA RTU3. This Modbus TCP communications link will accommodate monitoring of the new UV channel equipment to be installed as part of this project. The UV vendor will provide I/O mapping information for coordination with the SCADA integrator to accommodate SCADA monitoring of the UV system status.
   a. It is anticipated that up to 60 discrete tags in the UV system will be monitored by SCADA.
   b. It is anticipated that up to 20 real tags in the UV system will be monitored by SCADA.
5. RTU 4 will be added at the new blower building. It will have 2 MicroScan 5 cards.
6. RTU 5 and 5A will be added at the Dewatering Building. Each RTU will have 3 MicroScan

2.3 WIRING

A. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be no less than 18 AWG copper, insulated for not less than 600 volts, with a moisture and heat resistant material and flame retardant nonmetallic covering.

B. All wires are to be identified with permanent wire number markers at each termination point of the wire. Acceptable NEC and ISA wire colors for various voltage conductors are to be used.

C. Terminal blocks for field connections shall be suitable for No. 12 AWG wire and be complete with marking strip and screw connectors. Terminals shall be labeled to agree with identifications shown on supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. No less than 10% spare terminals shall be provided. Each control loop or system shall be individually fused and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

2.4 DEVICE IDENTIFICATION

A. All devices shall be permanently identified. The device and terminal identifications shall agree with those shown on the equipment drawings.

B. Nameplates shall be provided on the face of individual devices.

PART 3 EXECUTION

3.1 SUBMITTALS

A. Submit to the Owner, CD copies of software for the SCADA system. One copy of the software shall be of the base software control system. Two copies shall be provided with all programmed variables, parameters, and functions of the SCADA system.

3.2 INSTALLATION

A. General: The Contractor shall receive, handle and store all equipment and materials to be installed, being careful to prevent any damage during transport and storage. All equipment stored shall be protected from weather in a manner recommended by the manufacturer.

1. All equipment shall be handled and installed in accordance with written instructions and approved shop drawing details of the manufacturer and as required by the drawings.
2. If the Contractor determines that existing conditions do not permit proper installation, he shall immediately notify the Owner’s Representative.

B. Maintain existing programming for wastewater treatment plant monitoring and control functions that are not to be modified as part of this project.

C. Control system programming shall be performed to provide system monitoring and control functions and modifications. Specific revisions to be incorporated are indicated on Instrumentation and Control Schedules in the project drawings.

3.3 START-UP TESTING

A. Test system for proper function.

3.4 WITNESS TESTING

A. The OWNER, ENGINEER, regular operators, and the maintenance staff shall be notified 1 week in advance of the times and dates of site tests. Tests shall be performed that fully exhibit the control and monitoring functions as specified herein.

3.5 SUPERVISION, START-UP, SERVICE, AND TRAINING

A. Integrator's trained service engineer/technician shall provide installation supervision to the Contractor.

B. Integrator's trained service engineer/technician shall provide initial startup, calibration and adjustment of equipment.

C. Integrator shall, during the warranty period, furnish all service necessary to repair defective equipment or work, and no charges will be made for any service due to these reasons. A complete written report shall be furnished to the Owner and Engineer after each service visit, giving the reason for failure and recommendations to prevent recurrence.

D. Conditional service shall also be provided, upon request of the Owner, for a period of one year after final acceptance, up to two 8-hour days, on-site.

E. Maintenance Training: At start-up, the integrator shall provide eight (8) hours of maintenance training for the owner's personnel.

END OF SECTION 26 45 00

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SECTION 26 50 01 – BUILDING LUMINAIRES (LED)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCED STANDARDS

A. NFPA 70 - National Electrical Code
B. NFPA 101 - Life Safety Code

1.3 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, LED sources, drivers and traditional source ballasts.
2. Exit signs.
3. Lighting fixture supports.

1.4 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color-rendering index.
C. LED: Light Emitting Diode
D. Lumen: Measured output of lamp and luminaire, or both.
E. IESNA LM-79-08: photometric testing standard used for LED luminaires
F. Luminaire: Complete lighting fixture, including driver housing if provided.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Energy-efficiency data.

3. Life, output (lumens, CCT, and CRI), and energy-efficiency data for LED sources.
4. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. LED luminaires must be based on IESNA Absolute Photometry.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a ten-year historical and current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products using IESNA recommended methods.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

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

2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
B. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories with a ten-year historical and current accreditation under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
C. Comply with NFPA 70.

1.8 COORDINATION

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

1.9 WARRANTY

A. Special Warranty for products containing Light Emitting Diode (LED): Manufacturer's agrees to repair or replace components of indoor and outdoor luminaires that fail in materials or workmanship, including LED array and driver for a period of five (5)

years from the date of shipment from Manufacturer's facilities. The LED arrays in the Product(s) will be considered defective in material or workmanship only if a total of 15% or more of the individual light emitting diodes in the Product(s) fail to illuminate

PART 2 - PRODUCTS <S>

2.1 MANUFACTURERS

A. Products: As indicated on drawings. Lighting fixtures for this project shall be limited to the three manufactures listed.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA for ceiling compatibility for recessed fixtures.
B. Metal Parts: Free of burrs and sharp corners and edges.
C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
b. UV stabilized and absorbent.

2. Glass: Annealed crystal glass unless otherwise indicated.

F. Factory-Applied Labels: Comply with UL 1598. Include recommended LED and drivers. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. CCT and CRI for all luminaires.

G. The Contractor shall furnish, assemble, install, connect and lamp fixtures for all lighting outlets as shown in schedule on drawings. Continuous-row fixtures shall be supported by the fixture stud in outlet boxes, or fixture units not so supported shall be adequately supported from structural members by means of manufacturer provided mounted systems. Contractor must request mounting systems provided by manufacturer at time of quote and order. All outlet boxes shall be supported from building structure, independent or suspended ceilings. Contractor must request

mounting systems provided by manufacturer at time of quote and order.

2.3 DRIVER FOR LED UNITS

A. General Requirements for Electronic Drivers:

1. Must be UL approved for 120-277 VAC 50-60Hz.
2. Designed to match LED output needed.
3. Driver shall be designed for full light output unless dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating at 100% load: Less than 20 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Must comply with ANSI C62.41 (Category A), ANSI C82.11.
8. Must comply with FCC part 15
9. Current: +/- 5% accuracy.
10. Power Factor: 0.90 or higher.
11. Driver shall carry a minimum 5 year warranty.
12. Driver shall be designed for a 50,000 hour life.

B. Drivers for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

1. The entire unit shall be warranted for 5 years. Warranty shall start from the date of project final acceptance.

2. The unit shall have long life, energy saving, ultra-bright LED lamps that consume less than 5 watts per face. The LED's shall be connected in a series/parallel configuration such that the unlikely failure of one led will effect no more than one other LED. The lighting uniformity shall be better than 4:1 when measured over any illuminated area and average brightness shall exceed 6 ft Lambert. Life expectancy of LEDs shall be in excess of 20 years.

2.5 LIGHT EMMITTING DIODES

A. Indoor lighting:

1. LED must be within a 2.5 MacAdam ellipse minimum at 3500K
2. LED lumen maintenance must be tested per IESNA LM-80-08 and projected per IESNA TM-21-11
3. Life rating must be a minimum L70 at 100,000 hours and L86 at 60,000 hours in a 30 degrees C environment.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
B. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Installation methods for each fixture shall be as indicated or detailed and as recommended by the fixture manufacturer for the application. Supports such as mounting brackets, hangers, clamps, etc., shall be provided in the best practical manner consistent with good workmanship and appearance.
3. Fixtures shall be secured to the building structure to provide required support in a manner acceptable to the building structure type. The contractor shall refer also to the manufactures instructions.

4. Any fixture damaged during construction prior to final acceptance of the project shall be replaced or repaired to the satisfaction of the Engineer.

5. Contractor shall note architectural finish schedules and existing conditions and furnish proper mounting accessories or trim as required to properly mount each fixture type.

6. Recessed fixtures shall be provided with mounting frames or rings and shall finish flush to the ceiling without light leaks. Fixtures shall be connected by means of flexible metal conduit (max 6'-0" length) from outlet boxes mounted above or alongside the fixture.

7. Fixtures exposed to outdoor temperatures shall be rated for 0 degree Fahrenheit operation.

8. All exit lighting fixtures shall be mounted as indicated on the drawings and in

the fixture schedule.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly and reinstall.

C. Lay-in Ceiling Lighting Fixture Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
3. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in "Identification and Nameplates".

3.3 SITE LIGHTING

A. Light poles shall be hinged.

B. Area and Street Lighting conduit shall be direct buried, Schedule 40 PVC conduit, size and quantities shall be designated by electrical engineer on drawings. Contractor shall provide a Quazite type (or equal) underground lighting handhole at each pole base. Lighting conduit shall turn up into box and terminations made in handhole using NSI type connectors to splice lighting conductors. This will allow disconnection and removal or replacement of light pole without losing down stream street lights.

END OF SECTION 26 50 01

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SECTION 26 90 00 - PROJECT CLOSE-OUT

PART 1 - GENERAL

GENERAL:

RECORD DRAWINGS

The Electrical contractor shall keep a record copy of the bid set and fabrication drawings at the job site and shall accurately maintain a record with dimensions and elevations of all changes to the contract drawings as the job progresses. At the completion of the job, the electrical contractor shall obtain sepia reproducible from the Architect and shall make changes which occurred during construction on drawings and submit three (3) copies to the Engineer. The Engineer will check drawings and will return them to contractor with comments or statement of approval, as applicable.

DEMONSTRATION OF COMPLETE ELECTRICAL SYSTEMS:

After installation has been completed, equipment has been tested, systems placed in permanent operation, and all adjustments made, a competent start-up technician, or technicians, shall be provided for a period of two working days. This technician shall operate the systems during this 4 time, and during this time shall instruct the Owner's designated representatives in the operation and maintenance of the equipment. The start-up technicians shall be at the site continuously during working hours during the instructional period.

Operating and Maintenance Manuals:

The form in which the operating maintenance manual is to be presented shall be subject to approval by the Architect.

The following items, together with any other necessary and pertinent data, shall be included in the manual. This list is not necessarily complete and is only to be used as a guide.

- Settings of all control and switches for normal operation with description of control and its location.
- A check list for periodic maintenance of all equipment, with maintenance and cleaning instructions.
- As built wiring diagrams, interlock, and control diagrams for the equipment.
- Parts list for all replaceable service parts, and indicate where they may be purchased.

- Manufacturer's cuts and rating tables for all equipment, including copies of all factory record drawings and all other shop drawings.

- Test data on all equipment.

- Serial numbers of all principal pieces of equipment

- Manufacturers', suppliers', and subcontractors' names, addresses, and telephone numbers

The first page shall identify project and give name, address and phone number of Architect, Engineer, Mechanical and Electrical sub-contractors and any service companies involved and give name and night phone of each party representing the electrical contractor responsible for service during warranty period.

WARRANTIES:

Deliver to Owner all warranties, guarantees, etc. and obtain written receipts.

PUNCH LIST:

During construction period the A/E will issue punch lists. These items shall be completed before A/E will approve next application for payment. Final punch list work shall be completed before acceptance.

FINAL OBSERVATION AND ACCEPTANCE:

The architect or his authorized representative will entertain the request for final observation and acceptance only after the following items are done.

Submit a list of uncompleted items, if any, and advise when the items will be done.

Complete all items on A/E's pre-final punch list.

FINAL CLEAN UP:

During construction this contractor shall keep the site clear of debris and upon completion of construction he shall clean up the premises and to remove all evidence of his work.

The contractor shall resolve all questionable items to be corrected prior to an inspection by the Engineer.

GUARANTEE:

The guarantee shall be as stated in the General Conditions, and the General Provisions of this section.

CLOSE-OUT CHECK LIST:

Provide, perform and submit all the items included in the following close-out list. Additional requirements are stated in other sections of the specifications.

| Section | Item | Action |
|---|---|---|
| 26 0100 | Factory Record Drawings:<br>. Transformer<br>. Panelboards | Submit |
| 26 0100 | Certificate of Inspection by Code Authority | Submit |
| 26 0100 | Remove all debris and clean:<br>. Light Fixtures<br>. Lenses<br>. Lamps<br>. Equipment Interiors<br>. Electrical Rooms<br>. Interior of Panels, Switchboards, and Generator Sets | Perform |
| 26 0100 | Operation and Maintenance Manuals | Submit |
| 26 0100 | Equipment Warranties: A list of warranty contacts (names, addresses and phone numbers) must be submitted for each electrical item. | Submit |
| 26 0100 | Record Drawings | Submit |
| 26 0235 | 600 Volt Cable Test Report | Submit |
| 26 0235 | Feeder continuity and fault test | Submit |
| 26 0553 | Equipment Nameplates | Provide on all equipment. |
| 26 2416 | Panelboard Circuit Directory | Complete and Install |
| 26 2416 | Keys to owner | Submit |

| | | |
|---|---|---|
| 26 2726 | Receptacle Test & Labeling | Perform/Verify |
| 26 50 00 | Clean Light Fixtures, Lenses and Lamps. | Perform |
| 26 50 00 | Replace Lamps Used for Construction Purposes | Perform/Verify |

END OF SECTION 26 90 00

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removing surface debris.
2. Removing designated paving, curbs, and slabs.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities and structures where indicated.
5. Plugging abandoned utilities and filling abandoned structures where indicated.
6. Protecting plant life and structures designated to remain.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Topsoil and subsoil removal, proofrolling.
2. Section 31 23 16.23 - Rock Removal.

1.2 REFERENCES

A. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, published by the North Carolina Department of Transportation.

1.3 MEASUREMENT AND PAYMENT

A. Site Clearing – Division I:
1. Basis of Payment: Cost of all site clearing is to be included in lump sum cost of work. No separate payment will be made for this item.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Section 200 of the NCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Conform to applicable code for environmental requirements and disposal of debris.

PART 2 PRODUCTS – Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing plant life designated to remain is tagged or identified.

C. Identify waste area or salvage area for placing removed materials when materials are indicated to remain on site.

3.2 PREPARATION

A. Call local utility line information service indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

A. Locate, identify, and protect from damage utilities indicated to remain.

B. Protect trees, plant growth, and features designated to remain as final landscaping.

C. Protect bench marks and survey control points from damage or displacement.

3.4 CLEARING

A. Remove trees and shrubs within areas indicated on Drawings.

B. Remove stumps, main root ball, root system, surface rock, and pavements to depth of 12 inches below proposed Subgrade elevation.

C. Clear undergrowth and deadwood without disturbing subsoil.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from site.

B. Remove paving, curbs, and site slabs.

C. Where indicated on Drawings partially remove paving, curbs, and slabs. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities. Indicate removal termination point for underground utilities on Record Documents.

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

F. Do not burn or bury materials on site unless authorized in writing by authority having jurisdiction.

G. Leave site in clean condition.

END OF SECTION

SECTION 31 23 16
EXCAVATION AND FILL

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Excavating topsoil.
2. Excavating subsoil for buildings, pavements, and landscape.
3. Backfilling building perimeter to subgrade elevations.
4. Backfilling site structures to subgrade elevations.
5. Filling under pavements or slabs-on-grade.
6. Undercutting and filling over-excavation.
7. Disposal of excess material.

B. Related Sections:
1. Section 00 31 00 – Geotechnical Report
2. Section 31 10 00 - Site Clearing: Clearing site prior to excavation.
3. Section 31 25 13 - Erosion Controls: Controlling sediment and erosion from work of this section.
4. Section 31 23 16.13 - Trenching.
5. Section 31 23 16.23 - Rock Removal.

### 1.2 MEASUREMENT AND PAYMENT

A. All cost associated with excavation, fill and any on-site and off-site disposal of excess materials, except rock removal, shall be included in the lump sum project cost.

### 1.3 REFERENCES

A. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, published by the North Carolina Department of Transportation.

B. ASTM International:
1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D1557-12 – Standard Test Method for Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3 2700 kN-m/$m^3$)
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

7. ASTM D2434 – Standard Test Method for Permeability of Granular Soils (Constant Head).
8. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
10. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

C. Dewatering Plan: Describe dewatering methods to be used to keep excavations dry if required.

D. Samples: Submit, in air-tight containers, 10-pound sample of each type of fill to testing laboratory.

E. Materials Source DOT Approval: Submit certification that aggregate and soil material suppliers are approved by the State Department of Transportation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with Sections 225, 230, 235, 260, and 802 of the NCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Project location.

1.7 PROJECT CONDITIONS

A. Refer to Section 01 30 00 – Administrative Requirements.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Topsoil: Original surface soil typical of the area which is capable of supporting native plant growth. It shall be free of large stones, roots, waste, debris, contamination, or other unsuitable material which might hinder plant growth.

B. Subsoil: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension, debris, waste, frozen material, and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

C. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM, or SP-SC.

D. Structural Fill: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

E. Borrow Material: Conform to subsoil requirements.

### 2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable.
   1. TC Mirafi; Model 1100BX or equivalent.
   2. Alkzo Nobel Geosynthetic Co.
   3. Huesker, Inc.
   4. Tenax Corp.
   5. Tensar Earth Technologies, Inc.
   6. Substitutions: Equal per EJCDC® C-200 – Instructions to Bidders.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.

D. Verify underground structures are anchored to their own foundations to avoid flotation after backfilling.

E. Verify structural ability of unsupported walls to support loads imposed by fill.

## 3.2 PREPARATION FOR EXCAVATION

A. Call Local Utility Line Information service as indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Notify utility company to remove and relocate utilities.

D. Protect utilities indicated to remain from damage.

E. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

## 3.3 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, re-landscaped, or regraded without mixing with foreign materials for use in finish grading.

B. Do not excavate wet topsoil.

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

D. Remove from site excess topsoil not intended for reuse.

## 3.4 SUBSOIL EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, structures, slabs-on-grade, paving, landscaping, and construction operations.

C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.

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

E. Do not interfere with 45-degree bearing splay of foundations.

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

G. Trim excavation. Remove loose matter.

H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume. Remove larger material as specified in Section 31 23 16.23.

I. Notify Engineer and testing agency of unexpected subsurface conditions.

J. Correct areas over excavated with granular fill and compact as required for fill areas.

K. Remove excess and unsuitable material from site.

L. Repair or replace items indicated to remain damaged by excavation.

M. Excavate subsoil from areas to be further excavated, re-landscaped, or regraded.

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

O. When excavating through roots, perform Work by hand and cut roots with sharp axe.

P. Remove from site excess subsoil not intended for reuse.

Q. Benching Slopes: Horizontally bench existing slopes greater than 3:1 to key placed fill material into slope to provide firm bearing.

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

## 3.5 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support excavations more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished subgrade, or design sheeting and shoring to be removed at completion of excavation work.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

## 3.6 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 00 – Erosion Control.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

## 3.7 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.

C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
   1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
   2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

E. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

## 3.8 PROOF ROLLING

A. Proof roll areas to receive fill, pavement and building slabs to identify areas of soft yielding soils.
   1. Use loaded tandem-axle pneumatic tired dump truck or large smooth drum roller.
   2. Load equipment to maximum 50 tons gross weight and make a minimum of four passes with two passes perpendicular to the others.

B. Undercut such areas to firm soil, backfill with granular fill or structural fill, and compact to density equal to or greater than requirements for subsequent fill material.

C. Do not proof roll or undercut until soil has been dewatered.

## 3.9 BACKFILLING

A. Scarify subgrade surface to depth of 4 inches.

B. Compact subgrade to density requirements for subsequent backfill materials.

C. Backfill areas to contours and elevations with unfrozen materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

E. Place fill material in continuous layers and compact in accordance with Schedule at end of this Section.

F. Employ placement method that does not disturb or damage other work.

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Support foundation walls and structures prior to backfilling.

I. Backfill simultaneously on each side of unsupported foundation walls and structures until supports are in place.

J. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

K. Make gradual grade changes. Blend slope into level areas.

L. Remove surplus backfill materials from site.

## 3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling Within Building and Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of Backfilling Within Landscape Areas: Plus or minus 2 inches from required elevations.

## 3.11 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

D. Repair or replace items indicated to remain damaged by excavation or filling.

## 3.12 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.

B. Request visual inspection of bearing surfaces by Engineer and inspection agency before installing subsequent work.

C. Laboratory Material Tests: In accordance with ASTM D698.

D. In-Place Compaction Tests: In accordance with the following:
   1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
   2. Moisture Tests: ASTM D.

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

F. Frequency of Tests:
   1. Building and Pavement Areas: Twice per lift for every 5,000 square feet.
   2. Landscape Areas: Twice per lift for every 10,000 square feet.

## 3.13 SCHEDULES

A. Unless specified elsewhere in these specifications, the following shall be used as a fill schedule:

B. Under Pavement and Slabs:
   1. Maximum 8-inch compacted depth.
   2. Compact material to a minimum of 95 percent of maximum density, except the top 12 inches.
   3. Compact top 12 inches to a minimum of 98 percent of maximum density.

C. Under Landscape Areas:
   1. Maximum 8-inch compacted depth.
   2. Compact to minimum 90 percent of maximum density.

D. Footing Foundation Fill:
   1. Structural fill to maximum 12-inch compacted depth.
   2. Compact to 98 percent of maximum density.

E. Fill for Over Excavation:
   1. Granular fill in 18 to 24-inch lift to top of degraded soil.
   2. Place ahead of construction equipment.

END OF SECTION

SECTION 31 23 16.13
TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Excavating trenches for utilities and utility structures.
2. Bedding.
3. Backfilling and compacting to subgrade elevations.
4. Sheeting and Shoring.
5. Dewatering.
6. Compacting backfill material.

B. Related Sections:
1. Section 00 31 00 – Geotechnical Report
2. Section 31 23 16 - Excavation and Fill: Topsoil and subsoil removal from site surface.
3. Section 31 23 16.26 – Rock Removal.
4. Section 31 25 13 – Erosion Controls: Controlling sediment and erosion from work of this section.
5. Section 33 31 00 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding.

1.2 MEASUREMENT AND PAYMENT

A. Payment for trenching shall be included within the lump sum contract cost. No separate payment will be made for trenching.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
6. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

C. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, published by the North Carolina Department of Transportation.

1.4 DEFINITIONS

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

B. Utility Structures: Manholes, catch basins, inlets, valve vaults, hand holes, and other utility access structures as indicated on Drawings.

C. Trench Terminology:
   1. Foundation: Area under bottom of trench supporting bedding.
   2. Bedding: Fill placed under utility pipe.
   3. Haunching: Fill placed from bedding to center line of pipe.
   4. Initial Backfill: Fill place from center line to 6 to 12 inches above top of pipe.
   5. Final Backfill: Fill placed from initial backfill to subgrade.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of North Carolina.

C. Dewatering Plan if required: Describe methods of dewatering and disposal of water.

D. Product Data: Submit data for geotextile fabric indicating fabric and construction.

E. Samples: Submit to testing laboratory, in air-tight containers, 10-pound sample of each type of fill.

F. Materials Source: Submit name of imported fill material suppliers.

G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1505 of NCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

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

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Subsoil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as subsoil fill under optimum moisture conditions.

B. Granular Fill: Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SW, SP, SP-SM or SP-SC.

C. Foundation Stone: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

D. Bedding and Haunching Material:
   1. Rigid Pipe: Granular Fill.
   2. Flexible Pipe: Foundation Stone.

E. Bedding for Structures: Foundation Stone.

F. Initial Backfill to 6 inches Minimum Above Utility:
   1. Rigid Pipe: Subsoil Fill.
   2. Flexible Pipe: Foundation Stone.

G. Final Backfill to Subgrade:
   1. Under Pavement: Granular Fill.
   2. Under Landscape: Subsoil Fill.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable.
   1. TC Mirafi; Model 1100BX or equal.
   2. Alkzo Nobel Geosynthetic Co.
   3. Tensar Earth Technologies, Inc.
   4. Substitutions: Equal per Section EJCDC® C-200 – Instructions to Bidders.

PART 3 EXECUTION

3.1 PREPARATION

A. Call local utility line information service indicated on Drawings not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, rock outcropping, and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 LINES AND GRADES

A. Excavate to lines and grades indicated on Drawings.
   1. Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.3 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock up of 1/3 cubic yard, measured by volume. Remove larger material as specified in Section 31 23 16.26.

C. Perform excavation within 48 inches of existing utility service in accordance with utility's requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Remove water or materials that interfere with Work.

F. Trench Width: Excavate bottom of trenches maximum 16 inches wider than outside diameter of pipe or as indicated on Drawings.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.

H. Maintain vertical faces to an elevation equal to 12 inches above top of pipe.
   1. When Project conditions permit, side walls may be sloped or benched above this elevation.

2. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.

I. Support Utilities and Structures:
   1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines
   2. Support utilities crossing trench by means acceptable to utility company.
   3. Do not interfere with 45-degree bearing splay of foundations.
   4. Provide temporary support for structures above and below ground.

J. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by Engineer.
   1. Cut out soft areas of subgrade not capable of compaction in place.
   2. Backfill with foundation stone and compact to density equal to or greater than requirements for subsequent backfill material.

K. Trim Excavation: Hand trim for bell and spigot pipe joints where required. Remove loose matter.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

M. Place geotextile fabric over trench foundation stone prior to placing subsequent bedding materials.

## 3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation work unless approved by Engineer.

D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water, or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

## 3.5 SURFACE WATER CONTROL

A. Control and remove unanticipated water seepage into excavation.

B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Section 31 25 13.

C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

## 3.6 DEWATERING

A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.

B. Operate dewatering system continuously until backfill is minimum 2 feet above normal ground water table elevation.

C. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
   1. Supplement or modify dewatering system and provide other remedial measures to control water within excavation.
   2. Demonstrate dewatering system operation complies with performance requirements before resuming excavation operations.

D. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.

E. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

F. Remove dewatering and surface water control systems after dewatering operations are discontinued.

## 3.7 BEDDING, HAUNCHING, AND INITIAL BACKFILL

A. Place bedding full width of trench to the depth indicated on Drawings and compact to 95 percent maximum density. Excavate for pipe bells.

B. Install utility pipe and conduit in accordance with the respective utility section.

C. Support pipe uniformly along entire length of pipe.

D. Carefully place haunching material to center of pipe, rod and tamp material to fill voids and provide uniform support of pipe haunches. Compact to 90 percent maximum density.

E. Carefully place initial backfill to 6 inches above top of pipe or to depth indicated on Drawings. Compact to 95 percent maximum density.

## 3.8 FINAL BACKFILLING TO SUBGRADE

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place fill material in continuous layers and compact in accordance with schedule at end of this Section.

D. Employ placement method that does not disturb or damage utilities in trench or foundation perimeter drainage.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not leave more than 50 feet of trench open at end of working day.

G. Protect open trench to prevent danger to the public.

3.9 DISPOSAL OF EXCESS MATERIAL

A. Dispose of excess material offsite and legally.

B. Furnish Engineer with certificate of disposal site or agreement from private property owner.

3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.11 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform laboratory material tests in accordance with ASTM D698.

C. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
   2. Moisture Tests: ASTM D6938.

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

E. Frequency of Tests: Two tests per lift for every 1,000 feet of trench.

3.12 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.13 SCHEDULE OF COMPACTION

A. Under Pavement and Slabs:
   1. Granular Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 95 percent maximum density except the top 12 inches.
   3. Compact top 12 inches to minimum 98 percent maximum density.

B. Under Landscape Areas:
   1. Subsoil Fill in maximum 8-inch loose lifts.
   2. Compact to minimum 90 percent maximum density.

C. In Unstable or Unsuitable Trench Foundation Areas:
   1. Foundation Stone in maximum 12-inch loose lifts.
   2. Compact to 98 percent maximum density.

END OF SECTION

SECTION 31 23 16.26
ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Removing identified and discovered rock during excavation.
   2. Expansive tools to assist rock removal.
   3. Explosive tools to assist rock removal.

B. Related Sections:
   1. Section 31 23 16 - Excavation and Fill NC: Excavating and filling for road or site work.
   2. Section 31 23 16.13 - Trenching: Excavating and backfilling for utilities.

1.2 MEASUREMENT AND PAYMENT

A. Rock Removal and Off-Site Disposal
   1. Basis of Measurement for Trenches: By cubic yard calculated to maximum trench width of 36" wider than the pipe diameter and maximum depth of 6 inches below bottom of pipe measured before disintegration and removal.
   2. Basis of Measurement for mass excavation: By cubic yard, measured in the rock's original position and computed by the average end area method, excavated in accordance with the contract. The Engineer may elect to use Digital Terrain Modeling (DTM), provided by the Contractor, for determining the rock removal quantities. Contractor shall provide original cross sections for the determination of excavation quantities taken before any rock excavation begins. Contractor shall provide final cross sections taken after the excavation has been completed. Undercut excavation is limited to excavation 1 foot or less below the roadbed sub-grade, bottom of structure, or as recommended by the Engineer. Original and final cross sections will be taken by ground survey methods. No measurement will be made of any materials excavated outside of authorized excavation limits established by the Engineer or any materials excavated before original cross sections were performed.
   3. Basis of Payment: Includes preparation of rock for removal, explosive and mechanical disintegration of rock, removal from position and loading, removing from site, and any associated disposal site costs for spreading, grading and related erosion control. No payment will be made for over excavated work or for replacement materials.

1.3 REFERENCES

A. National Fire Protection Association:
   1. NFPA 495 - Explosive Materials Code.

1.4 DEFINITIONS

A. Rock: Sandstone, limestone, flint, granite, quartzite, slate, hard shale, or other similar solid mineral material with a volume in excess of 1/3 cubic yard that cannot be removed by a Caterpillar 225 or equivalent excavator with rock teeth, having a bucket curling force rated at

not less than 25,700 pounds without drilling or blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers

B. Should rock be encountered in two or more ledges, each ledge being not less than 3 inches thick and with underlying strata of earth, clay, or gravel not more than 12 inches thick in each stratum, the entire volume between the top of the top ledge and the bottom of the bottom ledge will be classified as rock.

C. Removal of Hard Material will not be considered rock excavation because of intermittent drilling and blasting that is performed solely to increase production.

D. Hard Material: Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of Rock, but which usually require the use of heavy excavation equipment, ripper/rock teeth, or jack hammers for removal.

## 1.5 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Submittal procedures.

B. Shop Drawings: Indicate proposed method of blasting, delay pattern, explosive types, and type of blasting mat or cover. Indicate intended rock removal method.

C. Structure Survey Report: Submit survey report on conditions of buildings and structures near locations of rock removal.

D. Rock Profile Survey: Rock profiles and volumetric calculations used to quantify rock excavation shall be certified by a NC Professional Licensed Surveyor and submitted to the Engineer for review and acceptance before the Contractor can receive payment for rock excavation and removal.

## 1.6 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 495 – Explosive Materials Code.

B. Seismic Survey Firm: Licensed company specializing in seismic surveys with five years documented experience.

C. Explosives Firm: Company specializing in explosives for disintegration of rock with five years documented experience.

## 1.7 PROJECT CONDITIONS FOR USE OF EXPLOSIVES

A. Conduct survey and document conditions of buildings near locations of rock removal prior to blasting; photograph existing conditions identifying existing irregularities.

B. Advise owners of adjacent buildings or structures, in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.

C. Obtain seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other work.

1.8 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Schedule Work to avoid disruption to occupied buildings nearby.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conform to NFPA 495 – Explosive Materials Code.

B. Explosives, Delay Devices, and Blast Mat Materials: Type recommended by explosive firm following seismic survey and required by authorities having jurisdiction.

C. Mechanical Disintegration Compound: Grout mix of materials that expand on curing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify site conditions and note subsurface irregularities affecting Work of this Section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical method.
   1. Drill holes and use expansive tools, wedges, and mechanical disintegration compound to fracture rock.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings and foundations.

D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 16 inches wider than pipe diameter.

E. Remove excavated materials from site.

F. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 31 23 16 – Excavation and Fill.

## 3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. Rock removal by explosive methods is prohibited when required within 100’ of an existing structure, basin, or building.

B. When rock is uncovered requiring explosives method for rock disintegration, notify Architect/Engineer prior to executing as follows.

C. Provide seismographic monitoring during progress of blasting operations.

D. Drill blasting holes within 12 feet of finished slope.

E. Disintegrate rock and remove from excavation.

F. Remove rock at excavation bottom to form level bearing.

G. Remove shaled layers to provide sound and unshattered base for footings and foundations.

H. In utility trenches, excavate to 6 inches below invert elevation of pipe and 16 inches wider than pipe diameter.

I. Remove excavated material from site.

J. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 31 23 16 – Excavation and Fill.

K. Notify affected parties 72 hours in advance of using explosives including:
   1. Duke Energy; Contact: Paul Beauty; Lincoln Combustion Turbine Station
   2. Home owners.
   3. Schools
   4. Fire department.
   5. Rescue.
   6. Emergency management.
   7. Local Law Enforcement department.
   8. NC Department of Transportation.
   9. Railroads.

## 3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request visual inspection of foundation bearing surfaces by Architect/Engineer and inspection agency before installing subsequent work.

END OF SECTION

SECTION 31 25 13
EROSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes installing, maintaining and removing:
   1. Silt Fence.
   2. Temporary Construction Entrances.
   3. Diversion Channels.
   4. Rip Rap.
   5. Check Dams/Sediment Tubes.
   6. Inlet Protection.
   7. Site Stabilization.
   8. Bank Stabilization.

B. Related Sections:
   1. Section 31 10 00 - Site Clearing.
   2. Section 31 23 16 - Excavation and Fill.

1.2 MEASUREMENT AND PAYMENT

A. General:
   1. All cost associated with erosion control shall be included in the lump sum cost.
   2. Basis of Payment: Includes all work related to erosion and sediment control.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-pound) rammer and a 457-mm (18-inch) drop.

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft$^3$ (2,700 kN-m/m$^3$)).
   3. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

C. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, published by the North Carolina Department of Transportation.

1.4 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit data on geotextile, posts, sediment socks, woven wire, concrete mix design, and pipe.

C. Manufacturer's Certificate: Certify products and aggregates meet or exceed specified requirements.

D. Closeout Submittals: Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Division 16 of NCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this Section.

PART 2 PRODUCTS

2.1 GEOTEXTILE MATERIALS

A. Engineering Fabric Materials: Non-biodegradable conforming to Section 1056 of NCDOT Standard Specifications:
   1. Silt Fence: Type 3, Class A or B Engineering Fabric.
   2. Under Rip Rap or Construction Entrances: Type 2 Engineering Fabric.

2.2 CHECK DAMS/SEDIMENT TUBES

A. Check dams/sediment tubes shall be of tubular design and constructed of a coarse composted decomposable material that is specifically designed for removal of solids from storm water runoff.

B. Manufacturers:
   1. Filtrexx.
   2. Silt Sock.
   3. GeoHay, LLC.
   4. Substitutions: Equal per Section EJCDC® C-200 – Instructions to Bidders.

2.3 STONE, AGGREGATE, AND SOIL MATERIALS

A. Stone for Wire Stone Outlet: Class B erosion control stone conforming to Section 1042 of the NCDOT Standard Specifications. Minimum size 5 inches, midrange size 8 inches, and maximum size 12 inches equally distributed.

B. Stone for Rip Rap: Class 1 erosion control stone conforming to Section 1042 of the NCDOT Standard Specifications. Minimum size 5 inches, midrange size 10 inches, and maximum size 17 inches equally distributed.

C. Washed Stone: Coarse aggregate, Gradation No. 57 conforming to Section 1005 and 1006 of the NCDOT Standard Specifications.

D. Aggregate for Construction Entrance: Coarse aggregate, Gradation No. 4 or larger with maximum size of 3 inch, conforming to Sections 1005 and 1006 of the NCDOT Specifications.

E. Soil Fill: Clean natural soil with a plasticity index of 15 or less that is free of clay, rock, or gravel lumps larger than 2 inches in any dimension; debris; waste; frozen material; and any other deleterious material that might cause settlement. Suitable material excavated from the site may be used as soil fill under optimum moisture conditions.

## 2.4 PLANTING MATERIALS

A. General: Conform to North Carolina Board of Agriculture rules and regulations as specified in Section 1060 of NCDOT Standard Specifications for seed, agricultural ground limestone, fertilizers, and mulch.

B. Temporary Seed Mixture:
1. Late winter and early spring: Rye and Annual Lespedeza (Kobe)
2. Summer: German Millet.
3. Fall: Rye.

C. Fertilizer: Commercial grade; recommended for grass.

D. Lime: ASTM C602, Class O agricultural ground limestone containing a minimum 80 percent calcium carbonate equivalent.

E. Mulch: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

F. Live Stakes: Materials shall be installed the same day as prepared or stored for no longer then 2 weeks in a refrigerated area that has been kept moist. Harvest and installation shall occur during the dormant season. (i.e., late fall, winter, if the ground is not frozen, to early spring before growth begins). Species shall be as noted on project drawings.

Live stakes shall be ½" to 3" diameter, 2 to 3 feet in length, angled on the bottom and cut flush on the top, with buds oriented upwards. Live stakes shall be living based on the presence of young buds and green bark. All side branches shall be cleanly trimmed so the cutting is one single stem.

G. Wooden Stakes: Provide wooden stakes 12 in. in length with a notch cut 1 in. from to top.

H. Coir Matting: Provide matting to meet the following requirements:
1. 100 % coconut fiber (coir) twine woven into a high strength matrix.

2. Thickness - 0.35 in. minimum.
3. Tensile Strength - 1740 lbs/ft minimum
4. Shear Stress – 4.5 lbs/sq. ft.
5. Flow Velocity- Observed 12 ft/sec
6. Weight - 23 oz/SY
7. Size – 9.84 ft. x 165 ft. (180 SY)
8. "C" Factor - 0.002
9. Open Area (measured) - 48%
10. Slopes – up to a maximum of 1:1

## 2.5 CONCRETE

A. Concrete: Class B concrete conforming to Section 1000 of the NCDOT Standard Specifications.
   1. Compressive strength of 2,500 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
   4. Maximum slump of 2.5 inches for vibrated concrete and 4 inches for non-vibrated concrete.
   5. Minimum cement content of 508 lbs per cubic yard for vibrated and 545 lbs per cubic yard for non-vibrated concrete.

## 2.6 PIPE MATERIALS

A. Pipe: Corrugated steel pipe and fittings conforming to Sections 1032-3 of NCDOT Standard Specifications.

## 2.7 ACCESSORIES

A. Posts for Silt Fence and Inlet Protection: Steel posts 5 feet long, 1-3/8 inches wide, minimum weight 1.25 lbs/ft. conforming to Section 1605 of NCDOT Standard Specifications.

B. Woven Wire Fence for Silt Fence: Minimum 32 inches high, minimum 5 horizontal wires, vertical wires spaced 12 inches apart, minimum 10 gage top and bottom wires, and minimum 12-1/2 gage; all other wires conforming to Section 1605 of NCDOT Standard Specifications.

C. Attachment Devices for Silt Fence: No. 9 staple, minimum 1-1/2 inches long, or other approved attachment devices.

## 2.8 SOURCE QUALITY CONTROL (AND TESTS)

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

C. Make rock available for inspection at producer's quarry prior to shipment. Notify Architect/Engineer at least seven days before inspection is allowed.

D. Allow witnessing of inspections and tests at manufacturer's test facility. Notify Architect/Engineer at least seven days before inspections and tests are scheduled.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.

C. Verify gradients and elevations of base or foundation for other work are correct.

### 3.2 SILT FENCE

A. Install in accordance with Section 1605 of NCDOT Standard Specifications at locations shown on Drawings.

B. Use wire fence with Class A fabric.

C. Class B fabric may be used without woven wire backing subject to the following:
1. Fabric is approved by Architect/Engineer.
2. Maximum post spacing is 6 feet.
3. Posts are inclined toward runoff source not more than 20 degrees from vertical.

### 3.3 TEMPORARY CONSTRUCTION ENTRANCES

A. Excavate and compact subgrade as specified in Section 31 23 16.

B. Install construction entrances to the dimensions and locations as shown on Drawings. Minimum thickness is 6 inches.

C. Mound aggregate near intersection with public road to prevent site runoff entering road.

D. Periodically dress entrances with 2-inch thick course aggregate when aggregate becomes clogged with soil.

### 3.4 DIVERSION CHANNELS

A. Excavate channel detailed.

B. Windrow excavated material on low side of channel.

C. Compact to 95 percent maximum density.

D. On entire channel area, apply soil supplements and sow seed as specified in Section 32 92 19.

E. Mulch seeded areas with hay as specified in Section 32 92 19.

3.5 ROCK LINING (RIP RAP)

A. Excavate to depth of rock lining as indicated on Drawings or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining and replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope. Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than 4 weeks.

C. Carefully place rock on geotextile fabric to produce an even distribution of pieces with minimum of voids and without tearing geotextile.

D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

3.6 CHECK DAM

A. Determine length required for ditch or depression slope and excavate, backfill, and compact foundation area to firm, even surface.

B. Check dams shall exceed the width of the normal ditch or channel flow line by at least 4 feet.

C. Check dams shall be secured using stakes installed through the middle of the check dam.

3.7 INLET PROTECTION

A. Install filter sock around inlet as indicated on Drawings.

3.8 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize, and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
   1. During non-germinating periods, apply mulch at recommended rates.
   2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 32 92 19 at 75 percent of permanent application rate with no topsoil.
   3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 32 92 19 permanent seeding specifications.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

## 3.9 BANK STABILIZATION

A. Provide a smooth soil surface free from stones, clods, or debris that will prevent the contact of the matting with the soil. Place the matting immediately upon final grading. Take care to preserve the required line, grade, and cross section of the area covered.

B. Unroll the matting and apply without stretching such that it will lie smoothly but loosely on the soil surface. Bury the top slope end of each piece of matting in a narrow trench at least 8 in. deep and tap firmly. Where one roll of matting ends and a second roll begins, overlap the end of the upper roll over the buried end of the second roll so there is a 6 in. overlap. Construct check trenches at least 12 in. deep every 50 ft. longitudinally along the edges of the matting or as directed by the Engineer. Fold over and bury matting to the full depth of the trench, close and tamp firmly. Overlap matting at least 6 in. where two or more widths of matting are installed side by side.

C. Place stakes across the matting at ends, junctions, and check trenches approximately 1 ft. apart with notch facing upslope. Place stakes along the outer edges and down the center of each strip of matting 3 ft. apart. Place stakes along all lapped edges 1 ft. apart. Refer to details in the plan sheets.

D. The Engineer may require adjustments in the trenching or staking requirements to fit individual site conditions.

E. Live stakes shall be installed on the channel banks as detailed on the project drawings. All lateral branches shall be carefully trimmed to avoid damage to the bark ridge and branch collar. A minimum of two buds (one lateral plus one terminal or two terminal) shall be above the planting depth. Stakes shall be driven into the ground using a rubber hammer or by creating a hole and slipping the stake into it. The stakes shall be tamped in at a right angle to the slope. Soil shall be firmly packed around the hole after installation. Split stakes shall not be installed. Stakes that split during installation shall be replaced.

## 3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

C. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T180.

D. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D6938.
   2. Moisture Tests: ASTM D6938.

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

F. Frequency of Tests: Twice per lift for every 10,000 square feet.

3.11 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. When sediment accumulation in sedimentation structures has reached a point one-half depth of sediment structure or device, remove and dispose of sediment.

C. Do not damage structure or device during cleaning operations.

D. Do not permit sediment to erode into construction or site areas or natural waterways.

E. Clean channels when depth of sediment reaches approximately one-half channel depth.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Aggregate base course on a prepared subgrade.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Preparing subgrade under base course.

1.2 REFERENCES

A. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$ (600 kN-m/m$^3$)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft$^3$ (2,700 kN-m/m$^3$)).
4. ASTM D2922 – Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

B. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Samples: Submit to testing laboratory 10-pound sample of each type of aggregate in airtight containers.

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

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Section 520 of NCDOT Standard Specifications.

B. Maintain one copy of document on site.

C. Furnish each aggregate material from single source throughout the Work.

D. Use sources participating in NCDOT Aggregate Quality Assurance/Quality Control Program.

## PART 2 PRODUCTS

### 2.1 MATERIALS

A. Aggregate Base Course: Coarse aggregate Type A or B with a gradation of ABC conforming to Sections 1005, 1006, and 1010 of NCDOT Standard Specifications.

B. Fine Aggregate: Sand gradation 1S or 2S conforming to Sections 1005 and 1006 of NCDOT standard Specifications.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verify existing conditions before starting work.

B. Verify substrate has been inspected and gradients and elevations are correct and dry.

### 3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting as specified in Section 31 23 16.

B. Do not place fill on soft, muddy, or frozen surfaces.

### 3.3 AGGREGATE PLACEMENT

A. Place aggregate in minimum 4-inch and maximum 10-inch layers and roller compact to specified density. When total thickness is 10 inches or less, place in one layer. When total thickness is greater than 10 inches, place in two equal layers.

B. Have each layer of material compacted and approved prior to placing succeeding layers.

C. Level and contour surfaces to elevations and gradients indicated on Drawings.

D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Use mechanical tamping equipment in areas inaccessible to roller compaction equipment.

### 3.4 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Thickness: 1/2 inch.

C. Maximum Variation from Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Independent laboratory, field inspecting, testing, adjusting, and balancing.

B. Laboratory Material Tests: Conform to Modified Proctor ASTM D1557 or Standard Proctor ASTM D698.

C. In-place Compaction Tests: Conform to:
   1. Density Tests: ASTM D1557, ASTM D2167, or ASTM D6938.
   2. Moisture Tests: ASTM D6938.

D. Compaction:
   1. 100 percent of maximum when measured in-place by standard methods.
   2. 98 percent of maximum when measured in-place by nuclear methods.

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

F. Frequency of Compaction Tests: Two tests per layer for every 5,000 tons of aggregate base course.

END OF SECTION

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SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphaltic Concrete Paving: Surface, binder, and base courses.
2. Prime Coat and Tack Coat.
3. Surface Sealer.
4. Quality Control and Testing.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Compacted subbase for paving.
2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
3. Section 32 13 13 - Concrete Paving: Concrete curbs.
4. Section 33 05 14 – Public Manholes and Structures: Frames and lids in pavement.

1.2 REFERENCES

A. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures, EPMS: Requirements for submittals.

B. Product Data: Submit product information and mix design.

C. Manufacturer's Certification: Certify products are produced at a plant approved by NCDOT and that products meet or exceed specified requirements.

D. Installer Certification: Certify installer is on list of NCDOT approved contractors with an approved Quality Control Plan.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Division 6 of NCDOT Standard Specifications.

B. Maintain on site one copy of each document.

C. Obtain materials from same source throughout.

D. Installer Qualification: Company specializing in performing work of this Section with minimum 5 years experience.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt base course or intermediate course when ambient air or road surface temperature is less than 35 degrees F. or surface is wet or frozen.

B. Do not place asphalt surface course when ambient air or road surface temperature is less that 50 degrees F. or wet.

C. Place bitumen mixture when temperature is not more than 15 degrees F. below temperature at when initially mixed and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

A. Asphalt Plant Mix Materials: Conform to Sections 1012 and 1020 of NCDOT Standard Specifications.

B. Prime Coat and Tack Coat: Conform to Section 1020 of NCDOT Standard Specifications.

C. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt concrete pavements. Conform to Section 1012 of NCDOT Standard Specifications.

D. Sand: Fine aggregate, gradation S1 or S2 conforming to Sections 1005 and 1006 of NCDOT Standard Specifications.

2.2 ASPHALT PAVING MIX

A. General: Use Superpave mix design conforming to Section 610 of NCDOT Standard Specifications.

B. Base Course: Type B-25.0B .

C. Intermediate Course: Type I-19.0B .

D. Surface Course: Type SF-9.5A.

E. Wedging or Leveling Mix: Conform to intermediate course.

2.3 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Submit proposed mix design of each class of mix for review prior to beginning Work.

C. Obtain materials from plant approved by NCDOT.

D. Test plant samples in accordance with Section 609 of NCDOT Standard Specifications.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify compacted subgrade and aggregate base is dry and ready to support paving and imposed loads.

B. Verify gradients and elevations of base are correct.

C. Verify utility structure frames and lids are installed in correct position and elevation.

### 3.2 PRIME COAT

A. Apply primer on aggregate base course at uniform rate of 0.2 to 0.5 gal/sq. yd. in accordance with Section 600 of NCDOT Standard Specifications.

B. Apply primer to contact surfaces of curbs and gutters.

C. Use clean sand to blot excess primer.

### 3.3 TACK COAT

A. Apply tack coat on asphalt or concrete surfaces at uniform rate of 0.04 to 0.08 gallons/square yard in accordance with Section 605 of NCDOT Standard Specifications.

B. Apply tack coat to contact surfaces of curbs and gutters.

C. Coat surfaces of utility structures with oil to prevent bond with asphalt pavement. Do not tack-coat these surfaces.

### 3.4 PLACING ASPHALT PAVEMENT

A. Install Work in accordance with Section 610 and 620 of NCDOT Standard Specifications.

B. Place asphalt within 24 hours of applying prime coat or tack coat.

C. Place asphalt in courses to the thicknesses and dimensions shown on the Drawings.

D. Place binder and intermediate courses.

E. Place surface course within 2 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.

F. Place surface course to thicknesses and dimensions shown on the Drawings.

G. Compact each course by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

H. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 JOINTS

A. Traverse Joints:
   1. When Work is suspended long enough to allow mixture to chill, construct transverse joint.
   2. Use butt joint when traffic will not pass over pavement.
   3. Use sloped wedge ahead of the end of pavement when traffic will pass over pavement. Place paper parting strip to removal of wedge.
   4. Tack coat edge of pavement prior to placing adjoining pavement.

B. Longitudinal Joints:
   1. Tack the edge of longitudinal joints prior to placing adjoining pavement.
   2. Pinch joint by rolling immediately behind the paver.
   3. Offset longitudinal joints in each layer by approximately 6 inches.

3.6 TOLERANCES

A. Density Compaction: Minimum of 92 percent of Maximum Specific Gravity ($G_{mm}$).

B. Flatness: Maximum variation of 1/8-inch measured with 10-foot straight edge.

C. Compacted Thickness: Within 1/4-inch.

D. Variation From Indicated Elevation: Within 1/2-inch.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Independent testing firm, field testing, and inspecting.

B. Perform Contractor Quality Control Program in accordance with Section 609 on NCDOT Standard Specifications.

C. Take compaction tests every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.

D. Take 6-inch diameter full depth pavement cores every 2,000 linear feet or fraction thereof per day on pavement placed at the paver lay down width.

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

## 3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.

B. Immediately after placement, protect pavement from mechanical injury for seven days or until surface temperature is less than 140 degrees F.

END OF SECTION

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SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete sidewalks.
2. Concrete integral curbs and gutters.
3. Concrete median barriers.
4. Concrete base and surface for parking areas and roads.
5. Small miscellaneous slabs.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Compacted subgrade for paving.
2. Section 32 11 23 - Aggregate Base Courses: Compacted base for paving.
3. Section 33 05 14 - Public Manholes and Structures: Frames and lids in paving.

1.2 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO)
1. AASHTO M 31 - Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
2. AASHTO M 32 - Steel Wire, Plain for Concrete Reinforcement.
3. AASHTO M 282 - Joint Sealants, Hot Poured, Elastomeric-Type, for Portland Cement Concrete Pavements.

B. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. ASTM International:
1. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
2. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
3. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
5. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
6. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

D. NCDOT Standard Specifications:

1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

## 1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures, EPMS: Requirements for submittals.

B. Concrete Mix Design: Submit concrete mix design 30 days prior to use of concrete.

C. Product Data: Submit data on joint materials, admixtures, and curing compounds.

D. Manufacturer's Certification: Certify products are produced at a plant approved by NCDOT and that products meet or exceed specified requirements.

E. Installer Certification: Certify installer is on list of NCDOT prequalified contractors with an approved Quality Control Plan.

F. Process Control Plan: Submit process control plan for delivering and placing concrete.

## 1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Division 7 (Roadway Pavement) and Sections 846 (Curbs and Gutters), 848 (Sidewalks and Driveways), 850 (Paved Ditch), and 852 (Traffic Islands) of NCDOT Standard Specifications, except as modified herein.

B. Maintain one copy of document on site.

C. Obtain cementitious materials from same source throughout.

## 1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section and prequalified by NCDOT.

B. Installer: Company specializing in performing Work of this Section and prequalified by NCDOT.

## 1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature or air temperature in the shade is 40 degrees F and falling or surface is wet or frozen.

B. Do not place concrete when air temperature in the shade is 95 degrees F and rising or when concrete temperature is greater than 95 degrees F.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Slip Form Methods: Use slip form methods wherever possible.

B. Fixed Form Materials: Metal conforming to Section 700 of NCDOT Standard Specifications.

2.2 JOINT MATERIALS

A. General: Conform to Section 1028 of NCDOT Standard Specifications.

B. Joint Filler: Sponge rubber or cork type conforming to ASTM D1751 (AASHTO M213) or bituminous, non-extruding, resilient type conforming to ASTM D1752 (AASHTO M153), Type 1; thickness as indicated on Drawings.

C. Silicone Sealant: Low modulus, cold applied, single component, chemically curing silicone material.
   1. Type NS: Non-sag silicone, toolable.
   2. Type SL: Self-leveling silicone, tooling not required.

D. Rubber Asphalt Sealant: Hot poured rubber asphalt joint sealer conforming to AASHTO M282 (ASTM D3406).

E. Bond Breaker:
   1. General: Product that does not stain or adhere to the sealant and is chemically inert and resistant to oils, gasoline, solvents, and primer.
   2. For On-Grade Pavements: Circular backer rod, diameter 25 percent larger than joint width.
      a. Type L, For Cold Pour Sealants Only: Closed cell expanded polyethylene foam. Use with Type NS silicone only.
      b. Type M, For Cold or Hot Pour Sealants: Closed cell polyolefin with closed skin over an open cell core.
   3. For Bridge Decks Only: Bond breaking tape, extruded polyethylene with pressure sensitive adhesive on one side, minimum 0.005 inches thick.

2.3 REINFORCEMENT

A. General: Conform to Section 1070 of NCDOT Standard Specifications.

B. Reinforcing Steel: ASTM A615 (AASHTO M 31); 60 ksi yield grade; deformed billet steel bars; epoxy coated finish.

C. Dowels and Tie Bars: ASTM A615 (AASHTO M 31); 60 ksi yield grade, plain steel, epoxy coated finish.

D. Welded Wire Fabric Steel: Deformed type, ASTM A497; unfinished.

## 2.4 CONCRETE MATERIALS

A. Concrete Materials: Provide fine aggregate, coarse aggregate, Portland Cement, fly ash, ground granulated blast furnace slag, water, air entraining agent, and chemical admixtures in accordance with Section 1000 of NCDOT Standard Specifications.

## 2.5 ACCESSORIES

A. Curing Compound: ASTM C309 (AASHTO M-148), Type 1 clear or translucent or Type 2 white pigmented.

## 2.6 CONCRETE MIX

A. Mix and deliver concrete in accordance with Section 1000 of NCDOT Standard Specifications.

B. Roadway and Area Pavement concrete: Air entrained conforming to the following criteria:
   1. Flexural Strength: 650 psi at 28 days.
   2. Slump: 1.5 inch maximum for slip form method, 3 inches maximum for fixed form hand methods.
   3. Minimum Cement Content: 526 pounds/cubic yard.
   4. Maximum Water/Cement Ratio: 0.559.
   5. Air Entrainment: Between 4.5 and 5.5 percent.

C. Class A Concrete for sidewalk, curb, curb and gutter, and other incidental site concrete: Air entrained, vibrated conforming to the following criteria:
   1. Compressive Strength: 3,000 psi at 28 days.
   2. Maximum Slump Vibrated: 3.5 inches.
   3. Minimum Cement Content: 564 pounds/cubic yard.
   4. Maximum Water/Cement Ratio for Angular Aggregate: 0.532.
   5. Maximum Water/Cement Ratio for Rounded Aggregate: 0.488.
   6. Air Entrainment: 6.0 percent plus or minus 1.5 percent.

D. Use accelerating admixtures in cold weather only when approved by the Engineer in writing. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by the Engineer in writing.

F. Use set retarding admixtures during hot weather only when approved by the Engineer in writing.

## 2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services.

B. Submit proposed mix design of each class of concrete to independent firm for review prior to commencement of Work.

C. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

D. Test samples in accordance with ACI 301 for compressive strength (cylinders) and flexural strength (beams.)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify compacted base course is acceptable and ready to support paving and imposed loads.

C. Verify gradients and elevations of base are correct.

D. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete.

B. Coat surfaces of manhole, catch basin, and other utility structure frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

A. Place reinforcement as indicated on Drawings.

B. Interrupt reinforcement at contraction and expansion joints.

C. Place dowels to achieve pavement and curb alignment as detailed.

D. Provide doweled joints 18 inches on center at transverse joints with one end of dowel set in capped sleeve to allow longitudinal movement.

3.5 PLACING CONCRETE

A. Place concrete in accordance with Section 700 of NCDOT Standard Specifications.

B. Place concrete using the slip form technique wherever possible.

C. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.

D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

E. Place concrete to pattern indicated on Drawings.

3.6 PAVEMENT JOINTS

A. Provide expansion, contraction, and construction joints as indicated on Drawings.

B. Place expansion joints at 60-foot maximum intervals. Place contraction joins at 20-foot maximum intervals. Align pavement joints with curb, gutter, and sidewalk joints.

C. Place joint filler between paving components and building or other appurtenances. Recess top of filler 1/2 inch for backer rod and sealant placement.

D. Saw cut contraction joints 3/16-inch wide or as indicated at an optimum time after finishing. Cut 1/3 into depth of slab.

3.7 SIDEWALK, CURB, AND CURB AND GUTTER JOINTS

A. Provide sawn joints at 5-foot intervals. Provide ¾-inch expansion joint at 30 feet maximum and between sidewalks and curbs and structures.

B. Align sidewalk, curb and gutter joints with pavement joints.

3.8 FINISHING

A. Area Paving: Heavy broom.

B. Sidewalk Paving: Light broom. Brush to 6-inch radius with smooth trowel joint edges.

C. Median Barrier: Light broom and trowel joint edges.

D. Curbs and Gutters: Light broom.

E. Inclined Vehicular Ramps: V-grooves with mechanical equipment and spring tines, perpendicular to slope.

3.9 EXPOSED AGGREGATE

A. Apply surface retarder where exposed aggregate finish is indicated.

B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate to match sample panel.

C. Sand blast concrete surfaces to achieve aggregate exposure surface to match sample panel.

3.10 CURING

A. Place curing compound on concrete surfaces immediately after finishing.

B. Cover with burlap or polyethylene film to protect from cold weather and rain.

3.11 JOINT SEALING

A. Separate pavement from vertical surfaces with ½-inch thick joint filler.

B. Place joint filler in pavement pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

C. Extend joint filler from bottom of pavement to within 1/2 inch of finished surface.

3.12 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.

B. Maximum Variation From True Position: 1/2 inch.

C. Maximum Variation in thickness: 1/2 inch.

3.13 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Prepare three concrete test beams for every 1,333 or less square yards of pavement for each class of concrete placed each day.

C. Prepare one additional test beam during cold weather and cured on site under same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken.

E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

F. Take one 4-inch diameter core for every 1,333 square yards or less of pavement for each class of concrete placed each day.

3.14 PROTECTION

A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.

B. Do not permit pedestrian or vehicular traffic over pavement for 7 days minimum after finishing.

3.15 SCHEDULES

A. Concrete Sidewalks: Class A Concrete, compressive strength of 3,000 psi at 28 days, 4 inches thick, buff color Portland cement, light broom finish.

B. Roadway Pavement Concrete: Non-reinforced, flexural strength of 650 psi at 28 days, 8 inches thick, wood float finish.

END OF SECTION

SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete parking bumpers.
   2. Parking bumper anchors.

B. Related Sections:
   1. Section 32 12 16 - Asphalt Paving.
   2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

A. ASTM International:
   1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit unit configuration, dimensions.

1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate the Work with pavement placement and parking striping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Gage Brothers Concrete Products.
   2. Southern Cast Stone Co., Inc.
   3. Parking Bumper Co.
   4. Substitutions: Equal per EJCDC© C-200 - Instructions to Bidders.

## 2.2 CONCRETE BUMPERS

A. Precast Reinforced Concrete Mix: Minimum compressive strength of 5,000 psi at 28 days, air entrained to 5 to 7 percent.

B. Use rigid molds constructed to maintain precast units uniform in shape, size, and finish. Maintain consistent quality during manufacture.

C. Embed reinforcing steel and drill or sleeve for two dowels.

D. Cure units to develop concrete quality and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

E. Minor patching in plant is acceptable providing appearance of units is not impaired.

## 2.3 CONFIGURATION

A. Nominal Size: 6 inches high, 8 inches wide, 6 feet long.

B. Profile: Manufacturer's standard cross section with sloped vertical faces, square ends, and drainage slots.

## 2.4 ACCESSORIES

A. Dowels: Steel, unfinished, 1/2 inch diameter, 24 inches long, pointed tip conforming to ASTM A615.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install units without damage to shape or finish. Replace or repair damaged units.

B. Install units in alignment with adjacent work.

C. Fasten units in place with two dowels for each unit bumper.

D. Core drill concrete pavement 1/8 inch larger than dowel. Seal annular space around hole with grout or sealant.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts and center drop for gates.
4. Manual gates and related hardware.
5. Barbed wire, 3 strand on fence top.

### 1.2 REFERENCES

A. ASTM International:
1. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
6. ASTM A585 - Standard Specification for Aluminum-Coated Steel Barbed Wire.
7. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
8. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
9. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
10. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
11. ASTM F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain Link Fence Fabric.
12. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
13. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
14. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
15. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
16. ASTM F1183 – Aluminum Alloy Chain Link Fence Fabric.
17. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. Chain Link Fence Manufacturers Institute:
   1. CLFMI - Product Manual.

C. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 SYSTEM DESCRIPTION

A. Fence Height: As indicated on Drawings.

B. Line Post Spacing: As indicated on Drawings, 12 feet maximum.

1.4 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures, EPMS: Requirements for submittals.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

C. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

D. Manufacturer's Installation Instructions: Submit installation requirements including post foundation anchor bolt templates if required.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

C. Operation and Maintenance Data: Procedures for submittals.

1.6 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Comply with Section 866 of NCDOT Standard Specifications except as modified herein. Maintain one copy of document on site.

C. Perform installation in accordance with ASTM F567.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years experience.

B. Installer: Company specializing in performing work of this section with minimum 5 years experience.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

B. Identify each package with manufacturer's name.

C. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Anchor Fence Inc.
2. Cyclone Inc.
3. Page Aluminized Steel Corp.
4. Boundary Fence and Railing Systems, Inc.

2.2 MATERIALS

A. Steel Pipe Framing: ASTM F1083 Schedule 40 galvanized steel pipe, welded construction; coating conforming to ASTM F1043 Type A on pipe exterior and interior.

B. Hot Rolled Steel Framing: ASTM A1011 hot rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum Grade 50; coating conforming to ASTM F1043 Type B on pipe exterior and interior.

C. Steel Fence Fabric: ASTM A392 zinc coated wire fabric or ASTM A491 aluminum coated wire fabric.

D. Aluminum Alloy Pipe Framing: ASTM B429.

E. Aluminum Alloy Fence Fabric: ASTM F1183

F. Barbed Wire: ASTM A121 galvanized steel or ASTM A585 aluminum coated steel; 12 gage thick wire, 2 strands, and 4 points at 3 inch on center.

G. Concrete: Class B concrete in accordance with Section 1000 of NCDOT Standard Specifications with 2500 psi compressive strength at 28 days.

2.3 COMPONENTS

A. Nominal fence height less than 6 feet:
1. Line Posts: 1.9 inch diameter.
2. Corner and Terminal Posts: 2.88 inch.
3. Gate Posts: 3.5 inch diameter.

4. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
5. Gate Frame: 1.66 inch diameter for welded fabrication.

B. Nominal Fence height 6 feet or more:
1. Line Posts: 2.38 inch diameter.
2. Corner and Terminal Posts: 3.5 inch.
3. Gate Posts: 4.5 inch diameter.
4. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
5. Gate Frame: 1.66 inch diameter for welded fabrication.

C. Fabric: 2-inch diamond mesh interwoven wire, 11 gage thick steel, 9 gage thick aluminum, top selvage knuckle end closed, bottom selvage knuckle end closed.

D. Tension Wire: 7 gage thick steel, single strand.

E. Tension Band: 3/16 inch thick by 3/4 inch wide steel.

F. Tie Wire: Aluminum steel wire, 9-gage.

## 2.4 ACCESSORIES

A. Caps: Cast steel galvanized, galvanized pressed steel, malleable iron galvanized, or aluminum alloy; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Cast steel galvanized or galvanized pressed steel to accommodate 3 strands of barbed wire, single arm, for placing vertical or sloped to 45 degrees as indicated on Drawings.

D. Gate Hardware: Fork latch with gravity drop, center gate stop and drop rod; two 180 degree gate hinges for each leaf and hardware for padlock keyed to match hardware as directed by Architect/Engineer.

## 2.5 GATES

A. General:
1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
2. Design gates for operation by one person.
3. Deliver gates factory assembled.
4. Finish is to be galvanized, aluminum coated, or PVC coated to match fence.

B. Swing Gates:
1. Fabricate gates to permit 180 degree swing.
2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

## 2.6 FINISHES

A. Galvanized Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 2.0 oz/sq. ft. coating.

B. Aluminum Coated Components and Fabric: Aluminum coating to ASTM A792/A792M for components and ASTM A491 for fabric; 0.40 oz/sq. ft.

C. Vinyl Coated Components and Fabric: Vinyl coating, 10 mil thick, over metallic coated wire, medium green, dark green or black color in accordance with ASTM F934 as indicated on Drawings.

D. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq. ft. coating.

E. Accessories: Same finish as framing.

2.7 CONCRETE

A. Concrete for foundations: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.
   1. Compressive strength of 3,000 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
   4. Maximum slump of 3.5 inch for non-vibrated concrete and 4 inch for vibrated concrete.
   5. Minimum cement content of 564 lbs per cubic yard for non-vibrated and 602 lbs per cubic yard for vibrated concrete.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories, and gates in accordance with ASTM F567.

B. Set intermediate, terminal, gate, and corner posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Footing Depth from Finished Grade:
   1. Line Posts for Nominal Fence Height Less Than 6 Feet: 2.25 feet.
   2. Line Posts for Nominal Fence Height 6 Feet or More: 2.5 feet.
   3. Corner, Gate, Pull, and Terminal Posts: 3 feet.

D. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

E. Install top rail through line post tops and splice with 6 inch long rail sleeves.

F. Install center and bottom brace rail on corner gate leaves.

G. Place fabric on outside of posts and rails.

H. Do not stretch fabric until concrete foundation has cured 28 days.

I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

J. Position bottom of fabric 2 inches above finished grade.

K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

M. Install bottom tension wire stretched taut between terminal posts.

N. Install support arms sloped inward, outward, or vertical as indicated and attach barbed wire; tension, and secure.

O. Support gates from gate posts. Do not attach hinged side of gate from building wall.

P. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf. Install latch, catches, and drop bolt.

Q. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

R. Connect to existing fence at an existing terminal post, new terminal post, or an existing line post converted to terminal post by installation of brace rails and brace rods.

S. Install posts with 6 inches maximum clear opening from end posts to buildings, fences, and other structures.

T. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

U. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

V. Extend concrete footings 1 inch above grade and trowel, forming crown to shed water.

W. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

## 3.2 ERECTION TOLERANCE

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Plumb: 1/4 inch.

C. Maximum Offset from Indicated Position: 1 inch.

D. Minimum distance from property line: 6 inches.

END OF SECTION

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SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Final grade topsoil for finish landscaping.
2. Testing Topsoil.
3. Supplying Topsoil.
4. Scarifying substrate surface.
5. Placing and lightly compacting topsoil.
6. Removing excess topsoil from site.

B. Related Sections:
1. Section 31 23 16 - Excavation and Fill: Cutting and filling to site subgrade.
2. Section 31 23 16.13 - Trenching: Backfilling trenches to subgrade.
3. Section 32 92 19 - Seeding.

1.2 REFERENCES

A. NCDOT Standard Specifications:
1. Standard Specifications for Road and Bridge Construction, latest edition, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Submittal procedures.

B. Test Results: Submit results of topsoil tests to determine soil amendments required.

C. Samples: Submit to testing laboratory for independent test, in air-tight containers, 10-pound sample of topsoil.

D. Materials Source: Submit name and location of imported materials source.

1.4 QUALITY ASSURANCE

A. Furnish each topsoil material from single source throughout the Work.

B. Perform Work in accordance with applicable portions of Section 235, 500, and 560 of NCDOT Standard Specifications.

C. Maintain one copy on site.

## PART 2 PRODUCTS

### 2.1 MATERIAL

A. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

B. Suitable material excavated from site, amended per requirements of tests is acceptable.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify building and trench backfilling have been inspected.

C. Verify substrate base has been contoured and compacted.

### 3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

### 3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting is required to thickness as scheduled. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, buildings, and pavement to prevent damage.

E. Lightly compact placed topsoil.

F. Remove surplus subsoil and topsoil from site.

G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Prohibit construction traffic over topsoil. Scarify and regrade disturbed areas.

3.7 SCHEDULES

A. Compacted topsoil thicknesses:
   1. Seeded Areas: 4 inches.
   2. Shrub Beds: As indicated on Drawings.
   3. Flower Beds: 12 inches.
   4. Trees: As indicated on Drawings.

END OF SECTION

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SECTION 32 92 19
SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fertilizing.
2. Seeding.
3. Hydroseeding.
4. Mulching.
5. Maintenance.

B. Related Sections:
1. Section 31 23 16 – Excavation and Fill
2. Section 31 25 13 – Erosion Control
3. Section 32 91 19 - Landscape Grading: Preparation and placement of topsoil in preparation for the Work of this Section.

1.2 REFERENCES

A. ASTM International:
1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

B. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

C. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Invoices or proof of purchase to verify quantities specified.

F. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; and, types, application frequency, and recommended coverage of fertilizer.

## 1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1660 of NCDOT Standard Specifications.
B. Maintain copy of document on site.

## 1.6 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing products specified in this Section with minimum 3 years documented experience.

B. Installer: Company specializing in performing work of this Section with minimum 5 years documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers showing percentage of seed mix, germination, inert matter and weeds; year of production; net weight; date of packaging; and location of packaging. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## 1.8 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

B. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition for minimum of three cuttings.

# PART 2 PRODUCTS

## 2.1 TOPSOIL MATERIALS

A. Conform to Section 32 91 19 – Landscape Grading. Topsoil: Original surface soil typical of the area, which is capable of supporting native plant growth; free of large stones, roots, waste, debris, contamination, or other unsuitable material, which may be detrimental to plant growth; pH value of 5.4 to 7.0.

## 2.2 SEED MIXTURE

A. Furnish materials in accordance with North Carolina Board of Agriculture rules and regulations as specified in Section 1660 of NCDOT Standard Specifications.

B. Seed Mixture and Rate:

1. Mountain Region:

| | |
|---|---|
| Tall fescue | 60 lbs/acre |
| Kentucky blue grass | 10 lbs/acre |
| Sericea lespedeza | 15 lbs/acre |
| Korean lespedeza | 10 lbs/acre |

2.3 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis. When test is not available, use 10-10-10 mixture of Nitrogen, phosphoric acid, and soluble potash.

C. Lime: ASTM C602, Class T or Class O agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

E. Erosion Fabric: Jute matting, open weave.

F. Herbicide: As required to combat type of weeds encountered.

G. Stakes: Softwood lumber, chisel pointed.

H. String: Inorganic fiber.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting Work.

B. Verify prepared soil base and topsoil are ready to receive the Work of this Section.

3.2 FERTILIZING

A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.

B. Apply fertilizer at application rate recommended by soil analysis.

C. Apply after smooth raking of topsoil and prior to roller compaction.

D. Do not apply fertilizer at same time or with same machine used to apply seed.

E. Mix fertilizer thoroughly into upper 2 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

A. Apply seed evenly in two intersecting directions at the rates shown above. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season:
   1. Mountain Region:
      a. Below 2,500 Feet: August 15 – September 1, March 1 – April 1.
      b. Above 2,500 Feet: July 25 – August 15, March 20 – April 20.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Roll seeded area with roller not exceeding 112 lbs/linear foot.

F. Immediately following seeding and rolling, apply mulch to thickness of 1/8 inch. Maintain clear of shrubs and trees.

G. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 6 lbs per 1,000 square feet evenly in one pass.

B. Apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

3.5 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 12 inches. Space stakes at 5 feet on center.

B. Cover seeded slopes where grade is greater than 3 H:1 V with erosion fabric. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas showing bare spots.

H. Repair washouts or gullies.

I. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

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SECTION 33 05 14
PUBLIC MANHOLES AND STRUCTURES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Precast reinforced concrete manholes and structures with tongue-and-groove joints with masonry transition to frames, lids, grates, anchorage, and accessories.
   2. Masonry manhole and structure sections with masonry transition to frames, lids, grates, anchorage, and accessories.
   3. Cast-in-place concrete manholes and structures with masonry transition to frames, lids, grates, covers, anchorage, and accessories.
   4. Structure connections to existing public utility lines.
   5. Bedding and backfill materials.

B. Related Sections:
   1. Section 31 23 16.13 - Trenching: Excavating and backfilling for manholes, structures, and foundation slabs.

### 1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

B. ASTM International:
   1. ASTM A48 - Standard Specification for Gray Iron Castings.
   2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Solid Masonry Units Made From Clay or Shale).
   3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   4. ASTM C55 - Standard Specification for Concrete Brick.
   5. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber gaskets.
   6. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   7. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   8. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Section Precast Concrete Water and Wastewater Structures.
   9. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
   10. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
   11. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

C. National Precast Concrete Association:

1. NPCA Quality Control Manual for Precast Plants.
2. NPCA Plant Certification Program.

D. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 22 01 - Electronic Project Management System and Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Shop Drawings:
1. Standard Fabrication: Indicate structure locations, elevations, sections, equipment support, piping sizes, and elevations of penetrations.
2. Custom Fabrication: Indicate design, construction and installation details, typical reinforcement and additional reinforcement at openings for each custom type, size and configuration.

C. Product Data: Submit manhole frames and lids, accessories, component construction, features, configuration, dimensions, and joint data.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of manholes and structures with rim and invert elevations.

F. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

A. Obtain precast concrete utility structures from single source.

B. Perform Work in accordance with Sections 825, 840, and 1525 of NCDOT Standard Specifications.

C. Maintain one copy of document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Certified by NPCA Plant Certification Program prior to and during Work of this section.

B. Installer: Company specializing in performing work of this Section with minimum five years experience.

C. Design custom utility structures under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Project location.

## 1.6 DELIVERY, STORAGE AND HANDLING

A. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing and moving precast manholes and drainage structures.

B. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer and identifying symbols, and numbers shown on Drawings to indicate its intended use.

## 1.7 ENVIRONMENTAL REQUIREMENTS

A. Masonry Work: Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 48 hours after completion of masonry work.

B. Cold Weather Requirements: ACI 530/530.1.

# PART 2 PRODUCTS

## 2.1 PRECAST REINFORCED MANHOLES AND STRUCTURES

A. Precast Manhole and Structure Sections: Reinforced precast concrete in accordance with ASTM C478.
   1. Joints for Precast Manholes and Structures for Sanitary Utility Sewer Service: O-ring rubber gaskets in accordance with ASTM C443.
   2. Joints for Precast Manholes and Structures for Other Utility uses: Butyl rubber gaskets in accordance with ASTM C990.

## 2.2 MASONRY CONSTRUCTION

A. Concrete Brick: ASTM C55, Grade S, Type II - Non-moisture controlled; except that the absorption of brick shall not exceed 10 lbs / cubic foot.

B. Clay or Shale Brick: ASTM C32, Grade SW, solid units.

C. Mortar: Conform to Section 1040 of NCDOT Standard Specifications proportioned as described below. Do not add more water than is necessary to make a workable mixture.
   1. Mix No. 1: 1 part Portland cement, 1/4 part hydrated lime, 3-3/4 parts mortar sand (maximum).
   2. Mix No. 2: 1 part Portland cement, 1 part masonry cement, 6 parts mortar sand (maximum).

D. Grout: Non-shrink, non-metallic in accordance with Section 1054 of NCDOT Standard Specifications with a compressive strength of at least 5,000 psi at 3 days.

## 2.3 CAST-IN-PLACE CONCRETE

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.
   1. Compressive strength of 2,500 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
   4. Maximum slump of 2.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
   5. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

## 2.4 FRAMES AND COVERS

A. Manufacturers:
   1. Barry Pattern and Foundry Co., Inc.
   2. East Jordan Iron Works
   3. McKinley Iron Works
   4. Neenah Foundry Co.
   5. Substitutions: EJCDC® C-200 – Instruction to Bidders.

B. Product Description: Grey cast iron ASTM A48, Class 30B; size and shape as indicated on Drawings. Live load rating of HS 20 in paved areas.

## 2.5 CONFIGURATION

A. Provide size and shape as indicated on Drawings.

B. Foundation Slab: Cast-in-place or precast reinforced concrete integral with bottom section, level top surface.

## 2.6 ACCESSORIES

A. Steps: Conform to local agency requirements, minimum 12 inches wide spaced vertically 16 inches on center.

B. Strap Anchors: Stainless steel capable of supporting pipe or accessories indicated on Drawings, minimum 1-inch wide x 1/8 inch thick.

C. Geotextile Filter Fabric: Type 1 Engineering fabric in accordance with Section 1056 of NCDOT Standard Specifications; non-woven, needle punched, non-biodegradable, and rot-proof.

## 2.7 BEDDING AND BACKFILL MATERIALS

A. Bedding: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

B. Backfill around Structures: As specified in Section 31 23 16.13 -Trenching.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify items provided by other Sections of Work are properly sized and located.

B. Verify built-in items are in proper location and ready for roughing into Work.

C. Verify correct size of manhole and structure excavation.

### 3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

B. Do not install manholes and structures where site conditions induce loads exceeding structural capacity of manholes or structures.

C. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify manholes and structures are internally clean and free from damage. Remove and replace damaged units.

### 3.3 INSTALLATION – GENERAL

A. Excavation and Backfill:
   1. Excavate and backfill for manholes and structures in accordance with Section 31 23 16.13 - Trenching in location and to depth shown. Provide clearance around sidewalls of manhole or structure for construction operations, backfill, and placement of geotextile filter fabric if required.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes or structures in dry trench.
   3. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation.

B. Place foundation slab, trowel top surface level.

C. Place precast manhole sections plumb and level, trim to correct elevations, anchor to foundation slab.

D. As Work progresses, install steps and other fabricated metal items.

E. Install cast-in-place manholes and structures supported at proper grade and alignment as shown on Drawings.

F. Cut pipe to connect to structure as indicated on Drawings.

G. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel as indicated on Drawings.

H. Set cover frames and covers level without tipping, to correct elevations.

## 3.4 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Install underground precast utility structures in accordance with ASTM C891.

B. Lift precast manholes and structures at lifting points designated by manufacturer.

C. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and manhole or structure remains clean.

D. Set precast manholes and structures bearing firmly and fully on stone bedding, 8-inch minimum thickness, compacted to 95 percent maximum density per Section 31 23 16.13 - Trenching or on other support system shown on Drawings.

E. Assemble multi-section manholes and structures by lowering each section into excavation. Install rubber gasket joints between precast sections in accordance with manufacturer's recommendations. Lower, set level, and firmly position base section before placing additional sections.

F. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

G. Joint sealing materials may be installed on site or at manufacturer's plant.

H. Verify manholes and structures installed satisfy required alignment and grade.

I. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with non-shrink grout.

## 3.5 MASONRY MANHOLE AND STRUCTURE INSTALLATION

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

B. Lay masonry units in running bond. Course one unit and one mortar joint to equal 8 inches.

C. Form flush mortar joints.

D. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other Work.

E. Install joint reinforcement 16 inches on center.

F. Place joint reinforcement in first and second horizontal joints above base pad and below cover frame opening.

## 3.6 CAST-IN-PLACE CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Prepare crushed stone bedding or other support system shown on Drawings to receive foundation slab as specified for precast manholes and structures.

B. Erect and brace forms against movement in accordance with Section 825 of NCDOT Standard Specifications.

C. Install reinforcing steel as indicated on Drawings and in accordance with Section 425 of NCDOT Standard Specifications.

D. Place and cure concrete in accordance with Section 825 of NCDOT Standard Specifications.

## 3.7 CONNECTION TO EXISTING SEWER WITH MANHOLE

A. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.

B. Carefully excavate around existing sewer line to adequate depth for foundation slab installation. Protect existing pipe from damage. Cut out soft spots and replace with granular fill compacted to 95 percent maximum dry density per Section 31 23 16.13 - Trenching.

C. Prepare crushed stone bedding or other support system shown on Drawings, to receive foundation slab as specified for precast manholes and structures.

D. Install manhole or structure around existing pipe in accordance with the appropriate paragraphs specified herein.

E. Block upstream flow at existing manhole or structure with expandable plug.

F. If flow is excessive, pump flow around new manhole to existing downstream manhole.

G. Use hydraulic saw to cut existing pipe at manhole or structure entrance and exit and along pipe length at a point halfway up the outside diameter on each side of the pipe. Bottom half of pipe shall remain as manhole flow channel. Saw cut to have a smooth finish with top half of pipe flush with interior of manhole or structure.

## 3.8 SANITARY MANHOLE DROP CONNECTIONS

A. Construct drop connections into sanitary manholes in accordance with Drawings.

B. Concrete encase pipe drop connection to minimum of 2 feet outside of manhole.

C. Form channel from pipe drop to sweep into main channel at maximum angle of 45 degrees.

## 3.9 CASTINGS INSTALLATION

A. Set frames using mortar and masonry as indicated on Drawings. Install radially laid concrete brick with 1/4 inch thick vertical joints at inside perimeter. Lay concrete brick in full bed of mortar and completely fill joints. Where more than one course of concrete brick is required, stagger vertical joints.

B. Do not install more than 3 courses of brick or more than 12 inches of masonry.

## 3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform soil compaction tests in accordance with Section 31 23 16.13 - Trenching.

C. Perform hydrostatic tests in accordance with Section 01 60 80 -Water Tightness for Hydraulic Structures.
   1. Notify Engineer 72 hours in advance of test and have witness test.

D. Test cast-in-place concrete in accordance with ASTM C39.

E. Test concrete manhole and structure sections in accordance with ASTM C497.

F. Vertical Adjustment of Existing Manholes and Structures:
   1. Where required, adjust top elevation of existing manholes and structures to finished grades shown on Drawings.
   2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
   3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated on Drawings.
   4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete.

END OF SECTION

SECTION 33 05 17
PRECAST CONCRETE VALVE VAULTS AND METER BOXES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Precast concrete valve vaults.
   2. Precast concrete meter boxes.

B. Related Sections:
   1. Section 31 23 16.13 – Trenching: Excavating and backfilling for vaults and meter boxes.
   2. Section 33 11 01 – Water Utility Distribution Piping meter vaults.

### 1.2 REFERENCES

A. ASTM International:
   1. ASTM A48 - Standard Specification for Gray Iron Castings.
   2. ASTM A536 - Standard Specification for Ductile Iron Castings.
   3. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   4. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
   5. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
   6. ASTM C891 - Standard Practice for Installation of Underground Precast Utility Structures.
   7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
   8. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joints Sealants.

B. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

### 1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Shop Drawing: Indicate plan, location and inverts of connecting piping.

C. Product Data: Submit data on valve vaults and meter boxes.

D. Manufacturer’s Certificates: Submit Statement of Compliance and supporting data from materials suppliers attesting that precast concrete valve vaults and meter boxes provided meet or exceed ASTM Standards and specification requirements.

E. Manufacturer's Installation Instructions: Submit special procedures for precast concrete valve vaults and meter boxes installation.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations and inverts of buried pipe, components and connections.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1525 of NCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 DELIVERY, STORAGE AND HANDLING

A. Transport and handle precast concrete units with equipment designed to protect units from damage.

B. Do not place concrete units in position to cause overstress, warp or twist.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE VALVES AND METER BOXES

A. Precast Sections: Reinforced precast concrete in accordance with ASTM C478.
   1. Joints: O-ring rubber gaskets in accordance with ASTM C443.

2.2 FRAMES AND COVERS

A. Manufacturers:
   1. U.S. Foundry & Manufacturing Corp.
   2. Halliday Products
   3. Bilco
   4. Substitutions: Equal per EJCDC® C-200 – Instructions to Bidders.

B. Product Description:
   1. Manhole Covers - Grey cast iron ASTM A48/A48M, Class 30B; size and shape as indicated on Drawings. Live load rating of HS 20 in paved areas.

   2. Hatch Door Covers –

      a. The hatch door leaf shall be 1/4" thick aluminum diamond pattern plate to withstand a live load of 300 pounds per square foot.
      b. Channel frame shall be 1/4" thick extruded aluminum with an anchor flange around the perimeter.

c. Doors shall be equipped with stainless steel hinges, steel pins, hardware, compression spring operators for easy operation and an automatic hold-open arm with release handle.
d. A stainless-steel slam lock with removable key and corrosive resistant handle shall be provided.
e. A 1-1/2" drainage coupling shall be located in the front right corner of the channel frame.
f. A bituminous coating applied to frame exterior where it comes in contact with concrete.

## 2.3 CONFIGURATION

A. Provide size and shape as indicated on Drawings.

B. Foundation Slab: Cast-in-place or precast reinforced concrete integral with bottom section, level top surface.

## 2.4 ACCESSORIES

A. Steps: Conform to local agency requirements, minimum 12 inches wide spaced vertically 16 inches on center.

B. Strap Anchors: Stainless steel capable of supporting pipe or accessories indicated on Drawings, minimum 1 inch wide x 1/8 inch thick.

C. Geotextile Filter Fabric: Type 1 Engineering fabric in accordance with Section 1056 of NCDOT Standard Specifications; non-woven, needle punched, non-biodegradable, and rot-proof.

## 2.5 BEDDING AND BACKFILL MATERIALS

A. Bedding: Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

B. Backfill around Structures: As specified in Section 31 23 16.13 -Trenching.

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Verify items provided by other Sections of Work are properly sized and located.

B. Verify built-in items are in proper location and ready for roughing into Work.

C. Verify correct size of manhole and structure excavation.

## 3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe.

B. Do not install vaults and structures where site conditions induce loads exceeding structural capacity of vaults.

C. Inspect precast concrete vaults immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

## 3.3 INSTALLATION

A. Excavation and Backfill:
   1. Excavate and backfill for vaults and meter boxes in accordance with Section 31 23 16.13 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations, backfill, and placement of geotextile filter fabric if required.
   2. When groundwater is encountered, prevent accumulation of water in excavations. Place structures in dry trench.
   3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation.

B. Place bedding and foundation slab; trowel top surface level if cast-in-place.

C. Install underground precast utility structures in accordance with ASTM C891.

D. Lift precast vaults and structures at lifting points designated by manufacturer.

E. When lowering vaults and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and manhole or structure remains clean.

F. Set precast vaults and structures bearing firmly and fully on stone bedding, 8-inch minimum thickness, compacted to 95 percent maximum density per Section 31 23 16.13 or on other support system shown on Drawings.

G. Assemble multi-section vaults and structures by lowering each section into excavation. Install rubber gasket joints between precast sections in accordance with manufacturer's recommendations. Lower, set level, and firmly position base section before placing additional sections.

H. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

I. Joint sealing materials may be installed on site or at manufacturer's plant.

J. Verify vaults and structures installed satisfy required alignment and grade.

K. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with non-shrink grout.

## 3.4 CASTINGS INSTALLATION

A. Set frames using mortar and masonry as indicated on Drawings. Install radially laid concrete brick with 1/4 inch thick vertical joints at inside perimeter. Lay concrete brick in full bed of mortar and completely fill joints. Where more than one course of concrete brick is required, stagger vertical joints.

B. Do not install more than 3 courses of brick or more than 12 inches of masonry.

## 3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform soil compaction tests in accordance with Section 31 23 16.13.

C. Perform hydrostatic tests.
   1. Notify Engineer 72 hours in advance of test and have witness test.

D. Test concrete manhole and structure sections in accordance with ASTM C497.

E. Vertical Adjustment of Existing Structures:
   1. Where required, adjust top elevation of existing vaults and structures to finished grades shown on Drawings.
   2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
   3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated on Drawings.
   4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete.

END OF SECTION

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SECTION 33 05 19
PRESSURE PIPING TIED JOINT RESTRAINT SYSTEM

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Tied joint restraint system.

B. Related Sections:
   1. Section 31 23 16.13 – Trenching: Excavation and Backfill for Work of this Section.
   2. Section 33 11 00 – Water Utility Distribution Piping: Pipe to be restrained.

### 1.2 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI B1.1 - Unified Inch Screw Threads.

B. ASTM International (ASTM):
   1. ASTM A36 - Standard Specification for Carbon Structural Steel.
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
   4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   7. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   8. ASTM A588 - Specification for High Strength Low-Alloy Structural Steel up to 50 ksi (345 MPa) Minimum Yield Point with Atmospheric Corrosion Resistance.
   9. ASTM B633 - Specification for Electrodeposited Coating of Zinc on Iron and Steel.
   10. ASTM F436 – Standard Specification for Hardened Steel Washers.

### 1.3 DESIGN REQUIREMENTS

A. Provide pressure pipeline with restrained joints at bends, tees, and changes in direction.

### 1.4 SUBMITTALS

A. Section 01 22 01 - Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Shop Drawings: Indicate restrained joint details and materials being utilized. Submit layout drawings showing piece numbers and locations. Also, indicate restrained joint locations.

C. Product Data: Submit catalog data for restrained joint details and installation instructions.

D. Design Data: Submit design calculations showing determination of restrained lengths and submit joint restraint details. Use joint restraint devices specifically designed for applications described in manufacturer's data.

E. Manufacturer's Installation Instructions: Submit installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Project Record Documents: Record actual locations of joint restraints.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years experience.

B. Installer: Company specializing in performing work of this Section with minimum 3 years documented experience.

PART 2 - PRODUCTS

2.1 TIED JOINT RESTRAINT SYSTEM

A. Manufacturers:
1. Dresser Piping Specialties.
2. Ebaa Iron Sales, Inc.
3. Star Pipe Products, Inc.
4. Substitutions: EJCDC® C-200 – Instruction to Bidders.

2.2 MATERIALS

A. Steel Types:
1. High Strength Low-Alloy Steel, ASTM A588, heat-treated.
2. High Strength Low-Alloy Steel, ASTM A588.
3. Carbon Steel ASTM A36.

2.3 COMPONENTS

A. Tie Bolts:
1. 5/8 inch for 2 inch and 3 inch mechanical joints, 3/4 inch for 4 inch to 12 inch mechanical joints and flanged joints, ASTM A588, Grade B; ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 pounds minimum for 5/8 inch and 60,000 pounds minimum for 3/4 inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.
2. 3/4 inch for 14 inch to 24 inch mechanical joints, ASTM A588, Grade B; ASTM A325, Type 3.

3. 1 inch for 30 inches and larger mechanical joints and flanged joints, ASTM A588/, Grade B; ASTM A325, Type 3; except increase tensile strength of full-body thread section to 100,000 pounds minimum by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.

B. Tie Nut: Hex nut for each tie bolt and tie rods; ASTM A563, Grade C3; plain, zinc plated, or galvanized.

C. Tiepin: 3/4 inch round bar stock for use on bends and hydrants, 6-inch hairpin shape, ASTM A588; ANSI B1.1; plain, zinc plated, or galvanized.

D. Tie Coupling: Used to extend continuous threaded rods and provided with center stop to aid installation; ASTM A588; plain, zinc plated, or galvanized.

E. Tie Clamp: Retainer clamp for ductile iron, asbestos cement and polyvinyl chlorite, push-on pipe in front of bell; ASTM A36; ASTM A307; ASTM A563, Grade A; plain, zinc plated, or galvanized.

F. Tie Rod: Continuous threaded rod for cutting to desired lengths; ASTM A588, Grade B; ASTM A325, Type 3; ANSI B1.1; plain zinc plated, or galvanized.

G. Tie Bar: Steel bar used to restrain push-in plugs; ASTM A36; plain, zinc plated, or galvanized.

H. Tie Washer: Round flat washers; ASTM A588, ASTM F436, Type 3; plain, zinc plated, or galvanized.

2.4 FACTORY APPLIED FINISHES – STEEL

A. Items to be zinc plated or galvanized to meet the following requirements:
1. ASTM B633 for electrodeposited coating of zinc on steel.
2. ASTM A153 for galvanizing iron and steel hardware.
3. Galvanizing for rolled, pressed, and forged steel shapes: ASTM A123; minimum 2.0 ounces per square foot coating thickness; galvanize after fabrication.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify pipe and fittings are ready to receive work.

B. Field measure and verify conditions.

C. Clean surfaces of pipe and fittings to receive tied joint restraint system.

3.2 INSTALLATION

A. Excavate and Backfill in accordance with Section 31 23 16.13 - Trenching.

B. Install pipe and fittings in accordance with Section 33 11 00 –Water Utility Distribution Piping.

C. Install joint restraint system so joints are mechanically locked together to prevent joint separation.

3.3 ERECTION TOLERANCES

A. Torque nuts on mating threaded fasteners to 45-foot pounds to 60-foot pounds for 5/8 inch nut.

B. Torque nuts on mating threaded fasteners to 75-foot pounds to 90-foot pounds for 3/4 inch nut.

C. Torque 1 inch nuts to 100-foot pounds to 120-foot pounds.

END OF SECTION

SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Pipe and fittings for potable water line and non-portable water line.
2. Valves and Valve Boxes
3. Air Release valves.
4. Underground pipe markers.
5. Thrust Blocking.
6. Pressure Testing

B. Related Sections:
1. Section 31 23 16.13 - Trenching: Excavation and backfill requirements.
2. Section 33 05 19 - Pressure Piping Tied Joint Restraint Systems.
3. Section 33 13 00 - Disinfecting of Water Utility Distribution: Disinfection of water piping.

### 1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. American Water Works Association:
1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water.
3. AWWA C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C153 - Standard for Ductile-Iron Compact Fittings.
7. AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings.
8. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
9. AWWA C509 - Resilient-Seated Gate Valves, 3 in. through 12 in. NPS, for Water and Sewage Systems.
10. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
11. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings.
13. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water Distribution.
14. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in. for Water Service.

C. ASTM International:
   1. ASTM A36 – Standard Specification for Carbon Structural Steel
   2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fitttings.
   4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   6. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   7. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

D. Manufacturer's Standardization Society of the Valve and Fittings Industry:
   1. MSS SP-60 - Connecting Flange Joint between Tapping Sleeves and Tapping Valves.

E. National Sanitation Foundation:
   1. NSF 61 - Drinking Water System Components - Health Effects

F. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 DEFINITIONS

A. Utility Company: Lincoln County.

1.4 SUBMITTALS

A. 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Shop Drawings: Indicate piping layout, including piping specialties.

C. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

F. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1510 of NCDOT Standard Specifications, latest edition, except as modified herein.

B. Perform work in accordance with utility company standards.

C. Maintain one copy of each document on site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with manufacturer's name and pressure rating labeling in place.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Store polyethylene materials out of sunlight.

PART 2 - PRODUCTS

2.1 WATER PIPING

A. Ductile Iron Pipe (DIP): AWWA C151. Bituminous outside coating: AWWA C151. Cement Mortar Lining: AWWA C104.
   1. Pipe Thickness Class: 50.
   2. Pressure Rating: 200 psi.
   3. Fittings: Ductile iron, AWWA C110. Compact fittings, Ductile Iron, AWWA C153.
      a. Pressure Rating: 200 psi minimum.
      b. Coating: Bituminous Coating, AWWA C110.
      c. Lining: Cement Mortar Lining, AWWA C104
   4. Joints:
      a. Mechanical Joints: AWWA C111.
      b. Push-On Joints: AWWA C111.
      c. Flanged Joints: AWWA C115.
      d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications.
      e. Tied Restrained Joints: Per Section 33 05 19.

B. Polyvinyl Chloride (PVC): AWWA C900 and AWWA C905, marked with NSF 61 designation for potable water use.
   1. Pipe Class: DR 18, 150 psi.
   2. PVC Pipe 4” and larger.
   3. Fittings:
      a. PVC, AWWA C900 and AWWA C905.
      b. Ductile Iron, Mechanical Joint, AWWA C110.

4. Joints:
    a. PVC, ASTM D3139 with ASTM F477 flexible elastomeric seals.
    b. Ductile Iron, Mechanical Joint, AWWA C111.
    c. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications.

C. PVC Pipe: ASTM D1785, Schedule 80 for buried pipe < 4".
    1. Fittings: ASTM D2466, PVC.
    2. Joints: ASTM D2855, solvent weld.

## 2.2 RESILIENT WEDGE GATE VALVES

A. Manufacturers:
    1. American Flow Control.
    2. Clow Valve Company.
    3. Mueller Company.
    4. Substitutions: Equal per EJCDC® C-200 – Instructions to Bidders.

B. Furnish materials in accordance with utility company or governing agency requirements.

C. Resilient Wedge Gate Valves: AWWA C509; iron body, bronze or ductile iron.
    1. Resilient seats.
    2. Stem: Non-rising bronze stem.
    3. Operating Nut: Square; open counterclockwise unless otherwise indicated.
    4. Ends: Flanged, mechanical joint or bell end connections.
    5. Coating: AWWA C550; interior/exterior.
    6. Sizes 12-Inch Diameter and Smaller: 200 psig.
    7. Sizes 16-Inch Diameter and Larger: 150 psig.

## 2.3 VALVE BOXES

A. Vales 12-Inch Diameter and Smaller: Cast iron, two-piece, screw type.

B. Valves Larger Than 12-Inch Diameter: Cast iron, three-piece, screw type; round base.

C. Cast iron lid marked "WATER".

## 2.4 AIR RELEASE VALVES

A. Furnish materials in accordance with utility company or governing agency requirements.

## 2.5 BACKFLOW PREVENTERS

A. Manufacturers:
    1. Watts Industries Model 909RS.
    2. Febco Model 825 YD.
    3. Wilkins Model 975SR
    4. Substitutions: Equal per Section 00 21 14 - Instructions to Bidders.

B. Reduced Pressure Backflow Preventers:
   1. Comply with ASSE 1013.
   2. Bronze body, with bronze internal parts and stainless-steel springs.
   3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## 2.6 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon and Trace Wire Tape: Brightly colored blue continuously printed with "WATER SERVICE" in large letters, minimum 6 inch wide by 4 mils thick, GNC magnetic detectable conductor manufactured for direct burial service.

## 2.7 PRECAST CONCRETE VALVE VAULTS AND METER BOXES

A. Conform to Section 33 05 14 – Public Manholes and Structures.

B. Provide size and type as indicated on Drawings.

## 2.8 CONCRETE FOR THRUST RESTRAINT, ENCASEMENT AND CRADLES

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications, January 2012.
   1. Compressive strength of 2,500 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
   4. Maximum slump of 2.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
   5. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

## 2.9 BEDDING AND COVER MATERIALS

A. Bedding for Rigid Pipe (DIP, PVC C900, PVC C905, and PCCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

B. Bedding for Flexible Pipe (PVC-IPS): Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

C. Backfill Around Pipe and Above Pipe: As specified in Section 31 23 16.13 -Trenching.

## 2.10 ACCESSORIES

A. Steel rods, bolt, lugs and brackets: ASTM A36 or ASTM A307 carbon steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing utility water main size, location, and inverts are as indicated on Drawings.

3.2 EXCAVATION

A. Excavate pipe trench in accordance with Section 31 23 16.13 - Trenching for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

C. Provide sheeting and shoring as required.

D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches in compacted depth; compact to 95 percent.

3.3 INSTALLATION – PIPE

A. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufactures' instructions.

B. Install PVC pipe in accordance with AWWA C605 and manufactures' instructions.

C. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.

D. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

E. Maintain minimum 10-foot horizontal separation and 18-inch vertical separation of water main from sewer piping or as required by local code.

F. Install pipe to indicated elevation to within tolerance of 1/2 inch.

G. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

H. Remove scale and dirt on inside and outside before assembly.

I. Flanged Joints: Not to be used in underground installations except within structures.

J. Route pipe in straight line. Relay pipe that is out of alignment or grade.

K. Install pipe with no high points. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Architect/Engineer.

L. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.

M. Prevent foreign material from entering pipe during placement.

N. Install pipe to allow for expansion and contraction without stressing pipe or joints.

O. Close pipe openings with watertight plugs during work stoppages.

P. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Disinfecting Water Utility Distribution Piping.

Q. Install underground marking tape continuously 12 inches above pipe line.

R. Establish elevations of buried piping with not less than 3 feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

3.4 INSTALLATION - VALVES

A. Install valves in conjunction with pipe installation; set valves plumb.

B. Provide buried valves with valve boxes installed flush with finished grade.

3.5 CONCRETE THRUST RESTRAINT

A. Provide valves, tees, bends, caps, plugs, and dead ends with concrete thrust blocks as indicated on Drawings.

B. Pour concrete thrust blocks against undisturbed earth. Locate thrust blocks at each elbow or change of pipe direction to resist resultant force and so pipe and fitting joints will be accessible for repair.

C. Do not encase fitting joints and flanges.

3.6 TIED JOINT RESTRAINT

A. Install tied joint restraint systems in accordance with Section 33 05 19 - Pressure Piping Tied Joint Restraint System.

3.7 BACKFILLING

A. Backfill and compact around sides and to top of pipe in accordance with Section 31 23 16.13 - Trenching.

B. Maintain optimum moisture content of material to attain required compaction density.

3.8 DISINFECTION OF POTABLE WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with Section 33 13 00 - Disinfecting Water Utility Distribution.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Compaction Testing: Perform soil compaction tests in accordance with Section 31 23 16.13 - Trenching.

C. Pressure Tests: Perform pressure test on potable water distribution system in accordance with AWWA C600.

D. Notification: Notify Engineer and Owner 72 hours in advance of test and have witness test.

E. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.

F. Pressure Test Procedure:
1. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct concurrent pressure and leakage tests.
2. Provide equipment required to perform leakage and pressure tests.
3. Conduct tests for at least two-hour duration.
4. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of hydrostatic pressure test.
5. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks removed and plug resulting piping openings.
6. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
7. Examine exposed piping, fittings, valves, hydrants, and joints carefully during pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
8. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

| |
|---|
| $L = (SD\sqrt{P}) / 148{,}000$ |
| L = allowable, in gallons per hour |
| S = length of pipe tested, in feet |
| D = nominal diameter of pipe, in inches |
| P = average test pressure during leakage test, in pounds per square inch (gauge) |

9. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION

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SECTION 33 13 00
DISINFECTING OF WATER UTILITY DISTRIBUTION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes disinfection of potable water distribution system; and testing and reporting results.

B. Related Sections:
   1. Section 33 11 00 - Water Utility Distribution Piping: Piping Product and Execution requirements for installation, testing, of water distribution piping.

### 1.2 REFERENCES

A. American Water Works Association:
   1. AWWA B300 – Standard for Hypochlorites.
   2. AWWA B301 – Standard for Liquid Chlorine.
   3. AWWA B302 – Standard for Ammonium Sulfate.
   4. AWWA B303 – Standard for Sodium Chlorite.
   5. AWWA C600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
   6. AWWA C651 – Standard for Disinfecting Water Mains.

### 1.3 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels for review.

C. Test Reports: Indicate results comparative to specified requirements.

D. Certificate: Certify cleanliness of water distribution system meets or exceeds specified requirements.

### 1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Disinfection Report:
   1. Type and form of disinfectant used.
   2. Date and time of disinfectant injection start and time of completion.
   3. Test locations.
   4. Name of person collecting samples.
   5. Initial and 24 hour disinfectant residuals in treated water in ppm for each outlet tested.
   6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:
   1. Date issued, project name, and testing laboratory name, address, and telephone number.
   2. Time and date of water sample collection.
   3. Name of person collecting samples.
   4. Test locations.
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
   6. Coliform bacteria test results for each outlet tested.
   7. Certify water conforms, or fails to conform, to bacterial standards of authority having jurisdiction.

D. Water Quality Certificate: Certify water conforms to quality standards of authority having jurisdiction, suitable for human consumption.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651and the requirements of the North Carolina Department of Environment, Health and Natural Resources; maintain one copy of document on site.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with start-up, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

A. Provide and attach required equipment to perform the Work of this Section.

B. Perform disinfection of water distribution system.

C. Introduce treatment into piping system.

D. Maintain disinfectant in system for 24 hours minimum.

E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.

F. Replace permanent system devices removed for disinfection.

G. Flushing of mains will be accomplished in such a manner as to minimize erosion and siltation to adjoining properties. Water velocity from drainage and/or blow-off will be dissipated as necessary to prevent erosion.

H. Contractor shall be responsible for providing means of dechlorinating all water flushed from the mains in accordance with Local and State authorities.

## 3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Disinfection, Flushing, and Sampling:
   1. Notify Engineer, and Owner72 hours in advance of test and have witness test.
   2. Disinfect pipeline installation in accordance with AWWA C651 and Section .1003 – Disinfection of Storage Tanks and Distribution Systems of the Rules Governing Public Water Systems, North Carolina Administrative Code Title 15a Subchapter 18C. Use of liquid chlorine is not permitted.
   3. The water main shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least 50 milligrams per liter (or ppm) in the water throughout the distribution system.
   4. The chlorine solution shall remain in contact with the interior surfaces of the water system for a period of 24 hours.
   5. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
   6. Legally dispose of chlorinated water. Apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
   7. After final flushing and before pipeline is connected to existing system or placed in service, employ an approved independent testing laboratory to sample, test, and certify water quality suitable for human consumption. At least two samples shall be taken from each test section.

END OF SECTION

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SECTION 33 31 00
SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sanitary sewer pipe and fittings.
   2. Underground pipe markers.
   3. Connection to existing manholes.
   4. Wye branches and tees.
   5. Sanitary Laterals.

B. Related Sections:
   1. Section 31 23 16.13 - Trenching: Excavation, bedding and backfill requirements for trenching required by this section.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
   2. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
   3. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
   4. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
   5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

B. American Water Works Association:
   1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. Through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
   2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   3. AWWA C153 - American National Standard for Ductile-Iron Compact Fittings for Water Service.
   4. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

C. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Permits: Submit copies of construction permits obtained for this Work.

C. Product Data: Submit catalog cuts and other pertinent data indicating proposed materials, accessories, details, and construction information.

D. Submit reports indicating field tests made and results obtained.

E. Manufacturer's Installation Instructions:
   1. Indicate special procedures required to install Products specified.
   2. Submit detailed description of procedures for connecting new sewer to existing sewer line and directional drilling, or pipe jacking installation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1520 of NCDOT Standard Specifications.

B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

B. Block individual and stockpiled pipe lengths to prevent moving.

C. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

D. Do not place pipe flat on ground. Cradle to prevent point stress.

E. Store UV sensitive materials out of direct sunlight.

1.8 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated.

1.9 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work with local sewerage authority. Convene pre-installation meeting minimum of one week prior to starting Work of this Section.

C. Notify affected utility companies minimum of 72 hours prior to construction.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPE AND FITTINGS

A. Ductile Iron Gravity Sewer Pipe: ASTM A746, bell and spigot ends.
   1. Pipe Class: Service type.
   2. Fittings: Ductile iron, AWWA C110. Compact fittings, AWWA C153.
   3. Joints: Rubber gaskets per AWWA C111.

2.2 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Furnish materials in accordance with authority having jurisdiction.

B. Flexible Pipe Boot: ASTM C923, ethylene propylene rubber (EPDM), Series 300 stainless steel clamp and stainless-steel hardware.

2.3 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Brightly colored green continuously printed with "SANITARY SEWER" in large letters, minimum 6 inches wide by 4 mils thick.

2.4 MANHOLES

A. Manholes: As specified in Section 33 05 14 – Public Manholes and Structures and indicated on Drawings; cover inscribed with “SANITARY SEWER”.

2.5 CONCRETE AND GROUT

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.
   1. Compressive strength of 2,500 psi at 28 days.
   2. Air entrained.
   3. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.
   4. Maximum slump of 2.5 inch for vibrated concrete and 4-inch for non-vibrated concrete.

5. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

B. Grout: Non-shrink, non-metallic in accordance with Section 1054 of NCDOT Standard Specifications with a compressive strength of at least 5,000 psi at 3 days.

2.6 BEDDING AND COVER MATERIALS

A. General: Conform to Section 31 23 16.13 - Trenching for bedding and backfill around and on top of pipe.

B. Bedding for Rigid Pipe (CIP, DIP, VCP, and RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

C. Bedding for Flexible Pipe (PVC, ABS): Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing sanitary sewer utility main size, location, and inverts are as indicated on Drawings.

3.2 EXCAVATION AND BEDDING

A. Excavate pipe trench in accordance with Section 31 23 16.13 - Trenching.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Section 31 23 16.13 - Trenching.

E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 16.13 - Trenching.

3.3 INSTALLATION – PIPE

A. Install in accordance with manufactures instructions and as indicated on Drawings.

B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.

C. Install VCP, fittings, and accessories in accordance with ASTM C12.

D. Install RCP, fittings, and accessories in accordance with ASTM C1479.

E. Install CIP and DIP, fittings, and accessories in accordance with applicable portions of AWWA C600.

F. Seal joints watertight.

G. Lay pipe to slope gradients indicated on Drawings with maximum variation from indicated slope of 1/8 inch in 10 feet. Begin at downstream end and progress upstream.

H. Ensure entire pipe is supported by bedding.

I. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Drawings or by Engineer.

J. Keep pipe and fittings clean until work is completed and accepted by Engineer. Cap open ends during periods of work stoppage.

K. Lay bell and spigot pipe with bells upstream.

L. Connect pipe to existing sewer system as indicated on Drawings at existing manhole or using doghouse manhole connection per Section 33 05 14 – Public Manholes and Structures.

M. Place haunching material, rod, and tamp per Section 31 23 17 – Trenching to eliminate voids.

N. Install underground marking tape continuously 18 inches above pipe line.

## 3.4 CONNECTION TO EXISTING MANHOLE

A. Core drill existing manhole to clean opening. Using pneumatic hammers, chipping guns, and sledge hammers is not permitted.

B. Install watertight neoprene gasket and seal with non-shrink concrete grout.

C. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint. Use epoxy binder between new and existing concrete.

D. Prevent construction debris from entering existing sewer line when making connection.

## 3.5 MANHOLE INSTALLATION

A. Install manholes in accordance with Section 33 05 14 – Public Manholes and Structures.

## 3.6 INSTALLATION - WYE BRANCHES AND TEES

A. Install wye branches or pipe tees at locations indicated on Drawings concurrent with pipe laying operations. Use standard fittings of same material and joint type as sewer main.

B. Maintain minimum 5 feet separation distance between wye connection and manhole.

C. Use saddle wye or tee with stainless steel clamps for taps into existing piping. Mount saddles with solvent cement or gasket and secure with metal bands. Layout holes with template and cut holes with mechanical cutter.

## 3.7 INSTALLATION - SANITARY LATERALS

A. Construct laterals from wye branch to terminal point at right-of-way or as indicated on Drawings.

B. Where depth of main pipeline warrants, construct riser type laterals from wye branch.

C. Maintain 3-foot minimum depth of cover over pipe.

D. Maintain minimum 5-foot separation distance between laterals.

E. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral. Install temporary marker stake extending from end of lateral to 24 inches above finished grade. Paint top 6 inches of stake with fluorescent orange paint.

## 3.8 BACKFILLING

A. Backfill around sides and to top of pipe in accordance with Section 31 23 16.13 - Trenching.

B. Maintain optimum moisture content of backfill material to attain required compaction density.

## 3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing bedding.

C. Perform the following tests:
   1. Gravity Sewer Testing:
      a. Low pressure air test.
      b. Infiltration test.
   2. Deflection Testing of Plastic Piping.
   3. Manhole Testing: Vacuum Test.
   4. Notify Engineer and Owner 72 hours in advance of test and have witness test.

D. Compaction Testing: In accordance with Section 31 23 16.13 - Trenching.

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

## 3.10 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SECTION 33 32 16
ROTARY DRUM THICKENER PUMP STATON (P-501 & P-502)

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete installation of one (1) factor built packaged sludge pump station as shown on the plans and specified herein.

B. Related Sections:

| | | |
|---|---|---|
| 1. | Section 01 22 01 – | Electronic Project Management System |
| 2. | Section 01 33 01 - | Submittal Procedures EPMS |
| 3. | Section 01 43 13 - | References |
| 4. | Section 01 70 00- | Execution and Closeout Procedures |
| 5. | Division 26- | Electrical |
| 6. | Section 40 91 16 | Magnetic Flow Meter |
| 7. | Section 46 71 33 - | Rotary Drum Thickening Equipment |

### 1.2 SYSTEM DESCRIPTION

A. The packaged sludge pump station shall consist of duplex solids handling sludge pumps with adjustable speed drives for the transfer of aerobically digested sludge from either of two digesters to a rotating drum thickener system with remote on/off controls included in the rotating drum thickener control panel. The pump station shall be complete with duplex, self-priming solids handling pumps, enclosure, suction and discharge piping and valves, manually operated air release ball valve, control panel and station appurtenances including ventilation blower, station heater, duplex receptacle and gauge kit.

B. Design Requirements - Each pump shall meet the following minimum requirements:

| | | |
|---|---|---|
| 1. | Capacity: | 400 gpm |
| 2. | Total Dynamic Head: | 40 feet Max / 25 feet Min |
| 3. | Static Head | 23 feet Max / 14 feet Min |
| 4. | Suction Lift | 16.7 feet Max / 1.2 feet Min |
| 5. | Shut-off Head: | 60 feet |
| 6. | Speed: | Variable Speed Drive<br>1332 RPM Max. & 1036 RPM Min |
| 7. | Impeller Diameter: | 9.75 inches |
| 8. | Minimum Sphere Passage: | 3 inches |
| 9. | Minimum Horsepower: | 10 Hp |

### 1.3 REFERENCES

A. Any reference to standard specifications refers to the most current published date of the following specifications unless noted:
   1. AWWA - Specifications as listed.

2. ASTM - Specifications as listed.
3. NEC -Specifications as listed.

1.4 SUBMITTALS

A. Shop Drawings: Shop Drawings shall be submitted to the Engineer for approval.
   1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.
   2. Wiring and schematic diagrams including accessories.
   3. Certified factory operational test, reprime performance test and characteristic curves showing field performance for each pump.
   4. Recommended spare parts list.
   5. A Service Manual shall be furnished for all mechanical equipment specified in this section. The manual shall contain a description of equipment, complete accessory and parts list, and complete installation, operation and maintenance instructions. An electronic copy of the manual shall be submitted for approval within 30 days after approval of shop drawings. After approval of the manual, six (6) additional copies shall be furnished.

1.5 QUALITY ASSURANCE

A. As minimum, any pump submitted shall be manufactured by a company having at least 10 years of documented experience in providing true self priming pumps in the size indicated above with at least 25 identically sized pumps to that specified at installations in the United States.

B. Pumps shall be designed and constructed in accordance with the standards of the Hydraulic Institute. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

PART 2 PRODUCTS

2.1 Station Enclosure:

A. The station enclosure shall contain and enclose all pumps and equipment, and shall be constructed to enhance serviceability by incorporating the following design characteristics:
   1. Access panels shall be provided. Panels shall be sized and placed to permit routine maintenance operations through the panel openings of the enclosure. For these purposes, routine maintenance shall include pump and motor inspection, drive belt adjustment, and pump clean-out. Panels shall be secured with tamper-proof hardware.
   2. Not less than four (4) access panels shall be provided with hinges and latches. Such panels shall provide access to frequently performed adjustments and inspections of the electrical controls. Hinges shall be the continuous type. Latches shall engage the enclosure at not less than two places and shall be protected by a keyed lock.
   3. One access panel shall contain a screened vent to maximize airflow for enclosure ventilation.

4. Station enclosure, less base, must be completely removable or able to be disassembled following the removal of reusable hardware. After removal or disassembly, no portion of the enclosure shall project above the surface of the base to interfere with maintenance operations or endanger personnel.
5. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.

B. Materials - The station enclosure shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with a minimum of 30 percent fiberglass, and a maximum of 70 percent resin.
1. Glass fibers shall have a minimum average length of 1-1/4 inches. Resin fillers or extenders shall not be used. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure a long life. They must be impervious to microorganisms, mildew, mold, fungus, corrosive liquids, and gases that can reasonably be expected to be present in the environment surrounding the wet well.
2. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide maintenance-free service, abrasion resistance, and protection from sewage, greases, oils, gasoline, and other common chemicals.
3. The outside of the enclosure shall be coated with a suitable pigmented resin compounded to insure long, maintenance-free life.

C. Enclosure Base: Station base shall be constructed of precast, reinforced concrete, bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength to resist deformation of structure during shipping, lifting, or handling. Base shall incorporate drainage provisions and shall be provided with an opening of sufficient size to permit piping and service connections to an adjacent gravity sewer. Station base shall incorporate anchor recesses for securing the pump station to the concrete pad supplied by the CONTRACTOR in accordance with the station plans.

D. A blower mounted and prewired in the station roof shall be sized to exchange station air volume at least once every two minutes. Blower motor shall energize automatically at approximately 70 degrees F, and turn off at 55 degrees F. The blower motor control circuit shall incorporate a thermal magnetic circuit breaker providing overcurrent and overload protection. Exhaust and inlet locations shall prevent the entrance of rain, snow, or debris.

E. Pump station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord and prewired grounding plug. Ungrounded heaters shall not be acceptable.

2.2 PUMP DESIGN:

A. Pump shall be horizontal, self-priming centrifugal type, designed specifically for handling raw unscreened domestic sanitary sewage or industrial waste. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section. Pump shall be prewired and connected electrically to the station control panel.

B. The pump manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

C. Reprime Performance: Pump must be capable of reprime lifts specified above at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that pump will prime and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Additional standards under which reprime tests shall be run are:
   1. Piping shall incorporate a spring-loaded discharge check valve downstream from the pump.
   2. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate an appropriate length of straight pipe and one 90-degree elbow.
   3. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
   4. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
   5. Liquid to be used for reprime test shall be water.
   6. Pump speed must be set at that required to achieve the specified head and flow as verified by suction and discharge gauges. The pumps shaft speed shall be measured and recorded.
   7. An approved automatic air release valve shall be installed between the pump discharge flange and the discharge check valve.
   8. Successful reprime shall be achieved when the sum of the suction and discharge gauge readings equals the specified TDH (total dynamic head).
   9. The results of the factory re-prime test shall be submitted to the engineer and accepted before equipment is shipped. Failure to obtain acceptance before shipment will result in the equipment being returned to the factory at the expense of the contractor.
   10. A field re-prime test identical to the factory test will be performed during equipment starting-up. The pumps must perform as specified in both factory and field tests. Failure to achieve the specified performance in the field will result in the penalty specified in Item L.
   11. Reprime is the ability of the pump to automatically restore normal function without operator assistance. The inability of the pump to meet the specified re-prime performance will result in replacement of the pump.
   12. Certified reprime performance test data, prepared by the pump manufacturer, shall be submitted to the engineer for approval prior to shipment.

D. Materials and Construction Features
   1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
   2. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
   3. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a positive lock clamp bar assembly. In consideration for safety, cap screw threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A non-metallic gasket shall prevent adhesion of the fill port cover to the casing while assuring a reliable seal.
   4. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
   5. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

E. Cover plate shall be cast iron Class 30. Design must incorporate the following maintenance features:

1. Retained by hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping.
2. A replaceable wear plate secured to the cover plate by weld studs and nuts shall be AISI 1015 HRS. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.
3. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75-200 PSI.
4. Two O-rings of Buna-N material shall seal cover plate to pump casing.
5. Pusher bolt capability to assist in removal of cover plate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.
6. Easy-grip handle shall be mounted to face of cover plate.

F. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate the following features:
   1. Seal plate and bearing housing shall be cast iron Class 30. Anti-rotation ribs shall be cast into the seal plate to reduce internal wear and maximize component life. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
      a. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
      b. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
      c. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
   2. Impeller shall be ductile iron, two vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall be statically or dynamically balanced. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
   3. Shaft shall be AISI 4140 alloy steel or approved equal.
   4. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir.
   5. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. The seal shall be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer shall be obligated, upon notification, to furnish a new seal, without charge to OWNER. The cost of replacement seals thereafter will be on a pro-rated basis as follows:

| Failure Within | Percentage Of New Seal Price |
|---|---|
| 2 Years | 25% |
| 3 Years | 50% |
| 4 Years | 75% |

6. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

G. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
   1. Clearances shall be maintained by a four-point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four-point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.
   2. There shall be provisions for additional clearance adjustment in the event adjustment tolerances have been depleted from the cover plate side of the pump. The removal of stainless steel tabbed spacers from the rotating assembly side of the pump shall allow for further adjustment as described above.
   3. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

H. An externally removable suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of pump without disturbing the suction piping or completely draining the casing. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

I. Pump shall include flange kit consisting of two ASA spool flanges that shall be one piece cast iron class 30 suitable for attachment to suction and discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other

J. Drain Kit
   1. Pumps to be supplied with a drain kit for ease of maintenance. The kit shall contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

## 2.3 DRIVE UNITS

A. Motors: The pump motors shall be horizontal, open drip proof, induction type, with normal starting torque and low starting current characteristics, suitable for 3 phase, 60 hertz, 460 volts, AC electrical current. The motors shall not be overloaded at the design condition. Each motor shall be in current NEMA design cast iron frame with copper windings.

B. Motors shall be inverter-duty, as defined by NEMA MG1, Section IV, Part 31 “Definite – Purpose Inverter-Fed Polyphase Motors.”

C. Drive Transmissions:
   1. Power shall be transmitted from motors to pumps by means of V belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions with capability.
   2. Each drive assembly shall have a minimum of two V-belts. In no case will a single belt drive be acceptable. Each V-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump.
   3. Drive systems with a safety factor of less than 1.5 to 1 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.

D. Belt Guards:
   1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed 1/2 inch.
   2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component.
   3. All metal shall be free from burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed a four-inch spacing.
   4. The guard shall be primed with a minimum of 1.5 mils of zinc based synthetic primer. A finish acrylic enamel coating (minimum 1.5 mils) shall be applied in accordance with Section 3, Color Definitions of ANSI 253.1; 1967, Safety Color Code for Marking Physical Hazards.

## 2.4 VALVES AND PIPING

A. Check Valves: Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O rings which shall be shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure.

B. Plug Valve:
   1. A 3 way plug valve must allow either or both pumps to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be cast iron with flanged end connections drilled to 125-pound standard. The drip tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Gauge Kit
   1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.
   2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

D. Automatic Air Release Valves:
   1. An automatic air release valve (ARV) shall be furnished with the pump station. The ARV shall be designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation.
   2. Valves shall provide visual indication of valve closure and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
   3. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material. Valves shall be field adjustable for varying discharge heads. Connection of the air release valves to the station piping shall include stainless steel fittings. Contractor to install independent air release lines to the pump station drain.

E. Flanged Header Pipe:
   1. Flanged header pipe shall be centrifugally cast, cast iron, complying with ANSI A21.6(AWWA C101) and Class 22 thickness, complying with ANSI A21.1.
   2. Flanges shall be Class 125 and comply with ANSI B16.1.

F. Station Piping:
   1. Pipe and flanges shall be threaded to ANSI B2.1 pipe thread and suitable thread sealant applied before assembling flange to pipe.
   2. Bolt holes shall be in angular alignment within ½ degrees between flanges. Flanges shall be faced and a gasket finish applied that shall have concentric grooves a minimum of 0.010 inch deep by approximately 0.030 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

2.5 FINISH

A. The pumps, piping, and exposed steel framework shall be cleaned with industrial grade chemical cleaner. The prime coat shall be a zinc base synthetic primer. The finish coat shall be automotive grade white acrylic enamel.

## 2.6 ELECTRICAL CONTROL COMPONENTS

A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.

B. A control panel shall be provided in a NEMA 1 stainless steel enclosure. The pump control panel shall contain all operating controls and instruments which include main power disconnect switch (By electrical contractor), circuit breakers, pump run indicators, pump mode selector (H-O-A), high pump temperature indicator, contacts for input to plant SCADA system, elapsed time meters, motor starters and overload relays. Separate circuit breakers shall also be provided for each pump and auxiliary device.

C. Each pump control shall monitor contacts to permit pump to be independently controlled from the Rotating Drum Thickener Control Panel when in the auto operation mode.

D. UL Label Requirement
   1. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for “Packaged Pumping System”. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub panel or control cover shall conform to UL descriptions and procedures.

E. Controls shall include contact relays to plant SCADA system to show pump run status, summary alarm for any pump alarm condition.

F. Branch Components
   1. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
   2. Circuit Breakers and Operating Mechanisms
      a. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
      b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
   3. Motor Starters
      a. An open frame, across the line, NEMA rated magnetic starter with under voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two

auxiliary contacts. Starters rated "O", "OO", or fractional size are not acceptable. Power contacts to be double break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.

2.7 PUMP MOTOR CONTROLLERS

A. Motor controllers shall be adjustable speed drives (“ASDs”).

2.8 VARIABLE FREQUENCY DRIVE

A. The variable frequency drive shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C

1. Relative Humidity: Less than 95% non-condensing
2. Altitude: Less than 1,000M (3300 ft) above sea level
3. Vibration: .006 inches displacement, 1G peak
4. Shock: 15G peak for 11mS (+/- 1.0mS)
5. Control Specification
6. Control System: Sinusoidal pulse width modulated voltage waveform
7. Frequency Accuracy: +/- 0.4% of max. frequency
8. Volts/Hertz Ratio: V/Hz user programmable
9. Operation Frequency: 0 to 400 Hz
10. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds

B. Digital Readout and Monitor

1. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuit status.

C. Protection

1. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.

D. The system protection will provide the following:

1. Intermittent overload - 50 to 150%
2. Current limit - 50 to 115%
3. Overcurrent - 220-300% of rated output current
4. Inverse time overload - 50 to 100%
5. Short circuit - Phase to phase or phase to ground
6. Overvoltage - 10% above input line or DC bus voltage
7. Undervoltage - 10% below line voltage
8. Power loss ride-through - 500mS

E. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:

1. Overcurrent
2. Short circuit
3. Overload
4. Overvoltage
5. Undervoltage
6. Overheat
7. Ground fault
8. Motor stalled
9. Power supply fault

F. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.

G. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.

H. Operational Functions:

1. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
2. Volts/Hertz patterns user selectable.
3. Maximum and minimum frequency limit adjustments.

G. Isolated Control Interface for Future: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

H. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

I. Self-Protection and Reliability Features:

1. Surge Suppression: Field-mounted surge suppressors complying with Section 26 43 13 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 3.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor-overtemperature fault.

J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

K. Controls and Indication
1. Speed control shall be automatic to maintain a preset flow to the Rotary Drum Thickener (RDT) based upon an 4-20 mA signal input from the RDT magnetic flow meter with a manual override. To accomplish this, provide an auto/manual selector switch for speed reference and speed potentiometer, single turn speed pot, mounted on enclosure door.
2. Status Lights: Door-mounted LED indicators displaying the following conditions:
   - Power on.
   - Run.
   - Overvoltage.
   - Line fault.
   - Overcurrent.
   - External fault.

L. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

M. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log.

N. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

O. Control Signal Interfaces: None required at this time. Include provisions to add in future.

P. Output Signal Interface: None required at this time. Include provisions to add in future.

Q. Remote Indication Interface: None required at this time. Include provisions to add in future.

R. PID Control Interface: None required at this time. Include provisions to add in future.

S. Enclosure: Suitable for location, made of stainless steel."

2.9 SCADA System Output

A. The control panel shall be equipped with SCADA signals (dry contacts) wired to terminals located inside the control panel for the following minimum signals:
   1. RDT Pump P-510 Run Condition
   2. RDT Pump P-510 Fail Condition
   3. RDT Pump P-510 HOA Out of Auto Condition
   4. RDT Pump P-511 Run Condition
   5. RDT Pump P-511 Fail Condition
   6. RDT Pump P-511 HOA Out of Auto Condition

2.10 Spare Parts –

A. There shall be furnished with the pump station the following minimum spare parts:
   1. One spare mechanical seal (complete), and with it all gaskets, seals, sleeves, O rings, and packing required to be replaced during replacement of the seal.
   2. One set of impeller clearance adjustment shims.
   3. One quart of seal lubricant.
   4. One cover plate O-ring.
   5. One rotating assembly O-ring.

PART 3 EXECUTION

3.1 HANDLING

A. All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times.

B. Equipment damaged by the weather, handling, or construction shall be immediately repaired or replaced to the Engineer's satisfaction.

## 3.2 TESTING AND INSTALLATION

A. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided.

B. Pump manufacturer shall be responsible for supplying and factory testing the complete pump system as a whole throughout the range of operation, including deadhead. The system to be tested shall include pumps mounted on vertical v-belt base, motors, discharge check valves, discharge plug valves and air release valve. Testing should be conducted in reference with Hydraulic institute Standard 14.6.3.4 acceptance grade 2B at the specified head, capacity rated speed and horsepower. Results should be documented by the pump manufacturer.

C. Contractor shall be responsible for discharge piping header from plug valves.

## 3.3 SERVICE

A. Equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the equipment manufacturer shall provide a minimum one (1) trip with eight (8) hours on site excluding travel time to inspect the complete installation, place the equipment in permanent operation, instruct the Owner's personnel in operation and maintenance, and perform field tests to insure proper operation.

B. A report of the field test results shall be provided and included in the final service manual. The report as a minimum shall contain performance information pertaining to pump shut-off head, pumping head and flow rate and voltage readings at the designated flow rate and head.

## 3.4 MANUFACTURER’S FIELD SERVICE

A. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for one day excluding travel to test and instruct representatives of the Owner and Engineer on the proper operation and maintenance of the equipment.

B. The manufacturer of the adjustable speed drive “ASD” shall provide start-up services and shall instruct Owner’s personnel on the operation and maintenance of the ASD.”

## 3.5 WARRANTY

A. The entire system shall be warranted for at least one year from the date of final acceptance by the Owner.

B. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures shall be warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

C. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.

D. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

END OF SECTION

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SECTION 33 34 00
SANITARY UTILITY SEWERAGE FORCE MAINS

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Force mains.
2. Bedding materials.

B. Related Sections:
1. Section 31 23 16.13 - Trenching: Excavation and backfill requirements.
2. Section 33 05 14 - Public Utility Manholes and Structures: Manholes vaults.
3. Section 33 05 19 - Pressure Piping Tied Joint Restraint Systems.

### 1.2 REFERENCES

A. ASTM International:
1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel
2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
3. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board
4. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
5. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association:
1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - ANSI Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
4. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 – Standard for Flanged Ductile-Iron Pipe With Threaded Flanges.
6. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
7. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
8. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
9. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and PVCO Pressure Pipe and Fittings.

10. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Transmission and Distribution.
11. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.

C. NCDOT Standard Specifications:
1. Standard Specifications for Roads and Structures, January 2012, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and Section 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Shop Drawings: Indicate piping layout, including piping specialties.

C. Product Data: Submit data on pipe materials, pipe fittings, valves, and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record location of pipe runs, connections, and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with Section 1510 of NCDOT Standard Specifications except as modified herein.

B. Perform work in accordance with utility company standards.

C. Maintain one copy of each document on site.

1.6 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this Section.

1.7 FIELD MEASUREMENTS

A. Verify field measurements and elevations are as indicated on Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not place materials on private property without written permission of property owner.

B. During loading, transporting and unloading, exercise care to prevent damage to materials.

C. Do not drop pipe or fittings.

D. Avoid shock or damage to pipe.

E. Take measures to prevent damage to exterior surface or internal lining of pipe.

F. Do not stack pipe higher than recommended by pipe manufacturer.

G. Store gaskets for mechanical and push-on joints in cool, dry location out of direct sunlight and not in contact with petroleum products.

1.9 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate the Work with connection to existing municipal sewer utility service and trenching.

PART 2 PRODUCTS

2.1 FORCE MAIN PIPING

A. Ductile Iron Pipe (4-inch through 12-inch)
   1. Pipe: AWWA C151 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids." Thickness Class 51 for push-on and MJ pipe and Class 50 for flanged pipe, unless shown otherwise on the drawings.
   2. Fittings: AWWA C110, grey or ductile iron
   3. Joints:
      a. Mechanical Joints: AWWA C111.
      b. Push-On Joints: AWWA C111.
      c. Flanged Joints inside structures: AWWA C115.
      d. Boltless Restrained Joints: Boltless, push-on type, joint restraint independent of joint seal. Conform to pipe manufacturers specifications.
      e. Tied Restrained Joints: Per Section 33 05 19.
   4. AWWA C111 push-on or mechanical for general buried service; flanged for exposed service unless shown otherwise on the drawings
   5. Coating:
      a. PROTECTO 401 or approved equal interior lining unless otherwise noted on drawings.
      b. Bituminous Outer Coating, AWWA C110 for buried service.
      c. Section 09 90 00 Painting for exposed service.

B. PVC Pipe (4-Inch Through 12-Inch):
   1. Pipe: AWWA C900 "Polyvinyl Chloride (PVC) pressure pipe. Pipe provided shall be cast iron pipe equivalent O.D. Pipe shall be pressure Class 150 (DR=18) unless shown otherwise on the drawings.
   2. Fittings: Cast or ductile iron fittings conforming to AWWA C110, with PROTECTO 401 or approved equal lining. PROTECTO 401 lined, gray-iron or ductile iron conforming to AWWA C104 and C110 for fittings size 4-inch through 12-inch or compact fittings conforming to AWWA C153
   3. Joints: Joints may be either integral bell and spigot or couplings. For cast or ductile fittings; AWWA C111, push-on.

C. PVC Pipe (1-Inch Through 4-Inch):
   1. Pipe: ASTM D-2241 "Polyvinyl Chloride (PVC) pressure water pipe. Pipe provided shall be iron pipe size. Pipe shall be pressure Class 200 (SDR 21) unless shown otherwise on the drawings.
   2. Fittings: Fittings less than 4-inch shall be PVC, Class 200, IPS with bells conforming to ASTM F477.
   3. Joints: Joints may be either integral bell and spigot or couplings.

## 2.2 VALVES

A. Valves and appurtenances shall be the type, size, and class shown on the plans. Valves shall have a heavy cast iron body with standard flanged ends, Class 125 with operating devices as specified or shown. Valves shall be at least the same class as the pipe on which they are used. All exposed valves shall be shop primed. Insofar as possible, all valves shall be by the same manufacturer.

B. Plug Valves: Shall be eccentric of the non-lubricated type with resilient faced plugs. Valve bodies shall be ASTM A126 Class B cast iron according to AWWA C504. Valves shall include the following features:
   1. Plugs shall be resilient faced cast iron, ASTM A126 Class B. The resilient covering shall be neoprene or hycar and suitable for use with sewage.
   2. Sleeve metal bearings which are sintered, oil impregnated, and permanently lubricated stainless steel conforming to Type 316, ASTM A743, Grade CF-8M or AISI Type 317 L shall be used. Non-metallic bearings are not acceptable.
   3. Valve shaft seals shall conform to AWWA C504 and AWWA C507 and shall utilize a multiple v-ring that is externally adjustable and repackable under pressure.
   4. Valve actuators shall be of the lever type for all valves 6 inches and smaller.

C. Swing Check Valves: Shall be bronze mounted with rubber faced bronze clapper disc seated by a bronze clapper arm against a bronze seat ring. The clapper shall have a lever and spring to assist closure. The spring tension shall be adjustable to set the speed of closure of the valve to the operating conditions in field. The clapper shall be secured to a stainless-steel shaft set in bronze bushings. Bushings shall be secured to the valve body with cap screws and sealed with O-rings.

D. Knife Gate Valves: Shall be cast iron body and flanges, lined with 316 stainless steel, EDPM seat, leak proof elastomer packing gland, precision-buffed stainless-steel gate and manual hand wheel actuator, ANSI Class 150.

2.3 AIR / VACUUM RELIEF VALVES

A. A.R.I. per Owner standard.

2.4 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon and Trace Wire Tape: Brightly colored green continuously printed with "SEWER FORCE MAIN" in large letters, minimum 6 inches wide by 4 mils thick, with magnetic detectable conductor manufactured for direct burial service.

2.5 PRECAST CONCRETE VALVE VAULTS

A. Conform to Section 33 05 14 – Public Utility Manholes and Structures.

B. Provide size and type as indicated on Drawings.

2.6 CONCRETE FOR THRUST RESTRAINT AND COLLARS

A. Concrete: Class B Concrete conforming to Section 1000 of the NCDOT Standard Specifications.

B. Compressive strength of 2,500 psi at 28 days.

C. Air entrained.

D. Water cement ratio of 0.488 with rounded aggregate and 0.567 with angular aggregate.

E. Maximum slump of 2.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.

F. Minimum cement content of 508 pounds per cubic yard for vibrated and 545 pounds per cubic yard for non-vibrated concrete.

G. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.

H. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

2.7 BEDDING AND COVER MATERIALS

A. Bedding for Rigid Pipe (DIP, PVC C900, PVC C905, and PCCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

B. Bedding for Flexible Pipe (PVC-IPS): Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

C. Backfill around Pipe and Above Pipe: As specified in Section 31 23 16.13 -Trenching.

2.8 ACCESSORIES

A. Steel Rods, Bolt, Lugs, and Brackets: ASTM A36/A36M or ASTM A307 carbon steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify existing sewer connection, size, location, and inverts are as indicated on Drawings.

3.2 EXCAVATION

A. Excavate pipe trench in accordance with Section 31 23 16.13 - Trenching for Work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated on Drawings.

B. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

C. Provide sheeting and shoring as required.

D. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 8 inches in compacted depth; compact to 95 percent.

3.3 INSTALLATION – PIPE

A. Install ductile iron pipe and fittings in accordance with AWWA C600 and manufactures' instructions.

B. Install PVC pipe in accordance with AWWA C605 and manufactures' instructions.

C. Handle and assemble pipe in accordance with manufacturer's instructions and as indicated on Drawings.

D. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

E. Maintain minimum 10-foot horizontal separation and 18-inch vertical separation of water main from sewer piping or as required by local code.

F. Install pipe to indicated elevation to within tolerance of 1/2 inch.

G. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs. Use only equipment specifically designed for pipe cutting. The use of chisels or hand saws will not be permitted. Grind edges smooth with beveled end for push-on connections.

H. Remove scale and dirt on inside and outside before assembly.

I. Route pipe in straight line. Relay pipe that is out of alignment or grade.

J. Install pipe with no high points unless indicated on Drawings. If unforeseen field conditions arise which necessitate high points, install air release valves as directed by Architect/Engineer.

K. Install pipe to have bearing along entire length of pipe. Excavate bell holes to permit proper joint installation. Do not lay pipe in wet or frozen trench.

L. Prevent foreign material from entering pipe during placement.

M. Install pipe to allow for expansion and contraction without stressing pipe or joints.

N. Close pipe openings with watertight plugs during work stoppages.

O. Install underground marking tape continuously 18 to 24 inches below finished grade

P. Establish elevations of buried piping with not less than 3feet of cover. Measure depth of cover from final surface grade to top of pipe barrel.

3.4 BACKFILLING

A. Backfill and compact around sides and to top of pipe in accordance with Section 31 23 16.13- Trenching.

B. Maintain optimum moisture content of material to attain required compaction density.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Perform soil compaction tests in accordance with Section 31 23 16.13 - Trenching.

C. Perform pressure test on sanitary sewer force mains in accordance with AWWA C600.

D. Notify Engineer and Owner 72 hours in advance of test and have witness test.

E. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.

F. Provide equipment required to perform leakage and hydrostatic pressure tests.

G. Test Pressure: Not less than 200 psi or 50 psi in excess of maximum static pressure, whichever is greater.

H. Conduct hydrostatic test for at least a two-hour duration.

I. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of hydrostatic pressure test.

J. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks removed and plug resulting piping openings.

K. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.

L. Examine exposed piping, fittings, valves, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, or joints discovered, following pressure test.

M. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

| |
|---|
| $L = (SD\sqrt{P})/148,000$ |
| L = allowable, in gallons per hour |
| S = length of pipe tested, in feet |
| D = nominal diameter of pipe, in inches |
| P = average test pressure during leakage test, in pounds per square inch (gauge) |

N. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.

END OF SECTION

SECTION 33 42 13
PIPE CULVERTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe culverts.
2. Joints and accessories.
3. Bedding.
4. Slope protection at pipe end.

B. Related Sections:
1. Section 01 33 01 – Submittal Procedures, EPMS
2. Section 31 23 16.13 - Trenching: Excavating and backfilling for culvert piping.
3. Section 31 25 13 - Erosion Control.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO M36 – Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains.
2. AASHTO M190 – Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
3. AASHTO M196 – Corrugated Aluminum Pipe for Sewers and Drains.
4. AASHTO M294 - Specification for Corrugated Polyethylene Pipe, 305- to 915-mm (12- to 36-In.) Diameter.
5. AASHTO M294 - Corrugated Polyethylene Pipe

B. ASTM International:
1. ASTM A929 - Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe.
2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
5. ASTM C506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.
6. ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. NCDOT Standard Specifications:
   1. Standard Specifications for Roads and Structures, latest edition, published by the North Carolina Department of Transportation.

1.3 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit data on pipe, fittings and accessories.

C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents:
   1. Accurately record actual locations of pipe runs, connections, and invert elevations.
   2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

C. Operation and Maintenance Data: Procedures for submittals.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe (RCP): ASTM C76, bell and spigot or tongue and groove ends.
   1. Pipe Class: Class III with Wall Type B (unless otherwise noted).
   2. Fittings: Reinforced concrete.
   3. Joints: ASTM C443, rubber compression gasket.

B. HDPE Corrugated Polyethylene Pipe: AASHTO M294, Type S or Type D.
   1. Fittings: PVC conforming to pipe specifications.
   2. Joints: ASTM F477, elastomeric gaskets.

C. Corrugated Metal Pipe (CMP):

   1. Steel Pipe: ASSHTO M36, Gage 14 unless otherwise noted.
   2. Aluminum Pipe: AASHTO M196.
   3. Fittings: Corrugated Steel or Aluminum to match pipe.
   4. Joints: Corrugated coupling bands, galvanized steel or aluminum to match pipe, minimum 10 inches wide; connected with two neoprene "O" ring gaskets per and two galvanized steel bolts.

D. Bituminous Coated CMP: AASHTO M 190, Coated inside and out with 0.050 inch thick bituminous coating.

2.2 BEDDING AND COVER MATERIALS

A. General: Conform to Section 31 23 16 for bedding and backfill around and on top of pipe.

B. Bedding for Rigid Pipe (RCP): Clean sand, slightly silty sand, or slightly clayey sand having a Unified Soil Classification of SP, SP-SM or SP-SC.

C. Bedding for Flexible Pipe (HDPE and CMP): Clean course aggregate Gradation No. 57 conforming to Sections 1005 and 1006 of the NCDOT Standard Specifications.

D. Cover and Fill: Conform to Section 31 23 16.13 - Trenching.

2.3 ACCESSORIES

A. Geotextile Fabric: Non-woven, non-biodegradable conforming to Section 1056 of the NCDOT Standard Specifications for Type 1 Engineering Fabric.

B. Concrete: Class A Concrete conforming to Section 1000 of the NCDOT Standard Specifications.
1. Compressive strength of 3,000 psi at 28 days.
2. Air entrained.
3. Water cement ratio of 0.488 with rounded aggregate and 0.532 with angular aggregate.
4. Maximum slump of 3.5 inch for vibrated concrete and 4 inch for non-vibrated concrete.
5. Minimum cement content of 564 pounds per cubic yard for vibrated concrete and 602 pounds per cubic yard for non-vibrated concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.3 EXCAVATION AND BEDDING

A. Excavate pipe trench in accordance with Section 31 23 16.13.

B. Excavate to lines and grades shown on Drawings or required to accommodate installation of encasement.

C. Dewater excavations to maintain dry conditions and preserve final grades at bottom of excavation.

D. Provide sheeting and shoring in accordance with Section 31 23 16.13.

E. Place bedding material at trench bottom, level continuous layer not exceeding 8-inch compacted depth; compact to 95 percent per Section 31 23 16.13.

F. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION – PIPE

A. Install in accordance with manufactures instructions and as indicated on Drawings.

B. Install plastic pipe, fittings, and accessories in accordance with ASTM D2321.

C. Seal joints watertight.

D. Begin at downstream end and progress upstream.

E. Keep pipe and fittings clean until work is completed and accepted by Engineer.

F. Lay bell and spigot pipe with bells upstream.

G. Repair surface damage to pipe with protective coating with two coats of compatible bituminous paint coating.

H. Install cover at sides and over top of pipe

3.5 PIPE ENDS

A. Place fill at pipe ends to match embankment slopes, concrete aprons, adjacent construction, end sections, or end walls as indicated on Drawings.

3.6 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Lay pipe to alignment and slope gradients noted on Drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.

C. Maximum Variation from Intended Elevation of Culvert Invert: 1/2 inch.

D. Maximum Offset of Pipe From Indicated Alignment: 1 inch.

E. Maximum Variation in Profile of Structure from Intended Position: 1 percent.

## 3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Request inspection prior to and immediately after placing bedding.

C. Soil Compaction Testing: In accordance with Section 31 23 16.13.

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

## 3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

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SECTION 35 20 16
SLUICE, CHANNEL AND WEIR GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sluice gates
2. Channel gates
3. Weir gates
4. Gate operators

B. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer.

C. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation and shall be the latest standard product of a manufacturer regularly engaged in the production of water control gates.

1.2 RELATED WORK

A. See the following specifications for related work:
1. Section 01 33 01 – Submittal Requirements – EPMS
2. Section 40 92 13.13 – Electric Motor Actuators
3. Section 43 32 63 – Ultraviolet Disinfection Equipment
4. Section 44 46 10 - Sequencing Batch Reactor (SBR) and Aerobic Sludge Digestion System

1.3 GOVERNING STANDARDS

A. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of ANSI/AWWA C561 latest edition.

1.4 QUALITY ASSURANCE

A. The gates supplied under this section shall be standard products of a manufacturer regularly engaged in the design and manufacturing of water control gates.

B. The manufacturer’s shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.
1. Gates shall be shop inspected for operation before shipping.
2. The manufacturer shall be ISO 9001:2015 certified and welders shall have certification for its welding to confirm compliance with ASME Section IX or AWS D1.6.

1.5 PERFORMANCE

A. Leakage – Gates shall be substantially watertight under the design head conditions. Leakage shall not exceed 0.05 US gallons per minute per foot of seal periphery under the design seating head and design unseating head.

B. Design Head - Gates shall be designed to withstand the maximum design head as shown on the contract drawings and in the gate schedule.

C. Seal Performance Test – The gate's sealing system shall have been tested through a cycle test in an abrasive environment and should show that the leakage requirements are still obtained after 25,000 cycles with minimum deterioration.

1.6 WARRANTY

A. The gates and manual operating accessories shall be covered by a five (5) year warranty from the manufacturer against defects in materials, design and workmanship. The warranty period will start from the date of delivery of the equipment to the installation site.

1.7 ACCEPTABLE MANUFACTURERS: RW Gate Company; Whipps, Inc.; Fountain-Aquanox, Golden Harvest or equal.

PART 2 PRODUCTS

All materials for the gates and operators shall be new and shall be furnished by the Contractor in accordance with the following requirements:

2.1 GENERAL

A. Contractor shall furnish sluice, channel and weir gates with operators conforming to the opening dimensions and elevations as shown on the plans and indicated on the gate schedule.

B. Description.
1. Weir Gates shall be downward opening with sealing on 3 sides providing level control on the upstream side by allowing flow over the top of the gate slide.
2. Channel Gates shall be upward opening with sealing on 3 sides providing flow control capability allowing flow through the open area below the gate or overflow of the top of the gate in a closed position.
3. Sluice gates shall be upward opening with sealing on 4 sides designed for submergence conditions with flow control by allowing flow through the open area of the gate.

C. Slide.
1. The slide consisting of a flat plate with welded reinforcing ribs shall be designed to withstand the design head specified in the gate schedule with a maximum deflection of 1/720 of the gate opening width or 1/16-inch, whichever is less, and with stresses in the slide limited to 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength, whichever is less. Minimum material thickness of all members of the slide shall be ¼ in.
2. The portion of the slide that engages the frame shall have a minimum thickness of 1/2-inch.

D. Frame.

1. The gate frame shall be constructed of structural members or formed plate welded to form a rigid one piece-frame. Gussets shall be provided over the complete guide to accommodate unseating head. Sandwich type guides are not acceptable. The frame shall be of the integral flange back design suitable for mounting on a concrete wall (CW) or frame embedded (FE) as specified in the gate schedule. The guide slot shall be made of materials noted in the material schedule.
2. Wall mounted guides shall have a minimum weight of 13 lbs/ft. Embedded guides and in-channel mounted guides shall have a minimum weight of 6 lbs/ft.
3. Guide extensions shall be Z-shaped or C-shaped and shall have a minimum weight of 6 lbs/ft. Angles are not acceptable for guide extensions.
4. The frame configuration shall be of the flush-bottom type on sluice gates and channel gates where applicable.
5. The frame configuration shall allow replacement of all seals without disassembly of any structural components and without the need to remove the gate frame from the concrete.
6. The frame shall be provided with lifting lugs on the top for handling and installation.

E. Yoke.

1. Gates specified as self-contained design shall include a yoke consisting of two C-channels mounted on top of the frame to permit mounting of the actuator with proper stem alignment. Angles are not acceptable for yoke members. The yoke shall be designed to allow removal of the slide and stem without disassembly of the yoke. The yoke shall be sized to limit deflection under the design load to a maximum of 1/360 of the gate opening width or 1/16-inch whichever is less.
2. The yoke design load must be considered as the vertical thrust generated by a 80 lbs (356 N) force on the crank or handwheel (for a manual actuator) or by the actuator in locked rotor condition (for an electric actuator). Per the latest edition of AWWA C561, the stresses in the yoke generated by the design load shall not exceed (for a manual actuator) 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength, whichever is less, or (for an electric actuator) 2/3 of the yield strength.

F. Guides and Seals

1. The guides shall be of the material noted in material schedule and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.
2. Side seals and top seals (where applicable) shall be of the self-adjusting type. Wedges, wedge pads and pressure pads are not acceptable. A continuous compression cord shall ensure contact between the guide and the gate in all positions. The sealing system shall maintain efficient sealing in any position of the slide and allow water to flow only in the open part of the gate.
3. J-bulb seals, P-seals or similar rubber seals are not acceptable in lieu of self-adjusting UHMWPE seals.
4. Bottom seals (where applicable) shall be set into the bottom member of the frame and shall form a flush-bottom. Bottom seals shall be bolted in place with stainless steel attachment bolts. Seals that are held in place solely with adhesives are not acceptable.

## 2.2 OPERATOR AND STEMS

A. Stem and Couplings - The operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb (178 N) effort on the crank or hand wheel. The stem shall have a minimum outside diameter of

1-1/2 inches. The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have machine rolled or machined cut threads of the full depth Acme type with a 16 micro inch finish or better.

B. For stems in more than one piece and with a diameter of 1-¾ inches and larger, the different sections shall be joined together by solid stainless-steel couplings. The couplings shall be grooved and keyed or bored and bolted and shall be of greater strength than the stem. Stems with a diameter smaller than 1 ¾ inches shall be pinned to an extension tube.

C. Gates having a width of 48 inches or greater and a width greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft. The tandem shaft shall be stainless steel. Aluminum is not an acceptable material for the tandem shaft.

D. Stem Guides - Stem guides shall be fabricated from stainless steel. The guide shall be equipped with a UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.

E. Stem Cover - Rising stem gates shall be provided with a clear butyrate stem cover that will not discolor for a minimum of five years. The stem cover shall have a cap and condensation vents as well as a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned to indicate the position of the gate.

## 2.3 LIFTING MECHANISM

A. Operators shall be of the types as shown on the drawings. All yoke or pedestal mounted manual operators shall have a minimum gear ratio of 2:1 and shall be suitable for operation with a portable operator. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb (178 N) on the crank or hand wheel and shall be able to withstand, without damage, an effort of 80 lb (356 N).

B. Non-self-contained gates shall be provided with a pedestal unless otherwise shown on the Contract Drawings. The pedestal shall be constructed of stainless steel and the adaptor plate and base plate shall have a minimum thickness of 1/2-inch. The tube shall have a minimum diameter of 4 inches.

C. Gearboxes shall be provided when required to maintain the operating force below 40 lb. All bearings and gears shall be totally enclosed in a weather tight ductile iron housing. The pinion shaft of crank-operated mechanisms shall be constructed of stainless steel and supported by roller or needle bearings. The operating shaft shall be fitted with a 2-inch square operating nut and removable crank. The crank shall be fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches (380 mm) and the maximum hand wheel diameter shall be 24 inches (600 mm).

D. Motorized Actuators - When required by the gate schedule or the drawings, motorized actuators shall be supplied as specified in specification Section 40 92 13.13.

## 2.4 MATERIALS

A. Sluice, Channel and Weir Gates

| Part | Material |
|---|---|
| Frame, stem guides, slide, stem extension | Stainless steel ASTM A-240, Type 304L or 316L |
| Guides, side and bottom seals, stem guide liner | Ultra-high molecular weight polyethylene (UHMWPE), ASTM D-4020-96 |
| Compression cord | EPDM ASTM 1056 |
| Bottom seal | EPDM ASTM 1056 |
| Bolts and Hardware | ASTM A276 or ASTM F593, grade 316 |
| Threaded stem | Stainless steel ASTM A-276, Type 304 or 316 |
| Fasteners | ASTM A276 or ASTM F593 and F594 GR2 for type 316 |
| Pedestal, wall brackets | Stainless steel ASTM A240, Type 316L |
| Gasket (between frame and wall) | non-shrink grout |
| Stem cover | Butyrate ASTM D-707 |
| Thrust nut and lift nut | Manganeze bronze , ASTM B584, UNS-C86500 |

PART 3 EXECUTION

3.1 HANDLING

A. All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times. Equipment damaged by the weather, handling or construction shall be immediately repaired or replaced to the ENGINEER's satisfaction.

3.2 INSTALLATION

A. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided.

B. The Contractor shall provide a finish coat on the ductile iron operator housing after installation of the gate assembly.

3.3 FIELD TESTS

A. Following the completion of each gate installation, the gates shall be operated through at least two complete open/close/open cycles. If an electric or hydraulic operator is used, limit switches shall be adjusted following the manufacturer's instructions.

B. Gates should be checked for leakage by the Contractor with a written report documenting the leakage rates provided to the Engineer.

PART 4 GATE SCHEDULE

| Gate Identification | Gate Location | Gate Type | Size W x H | Operating Floor Elev. | Invert Elev. | Head Seating (S) Unseating (U) | Mounting | Operator |
|---|---|---|---|---|---|---|---|---|
| SG-101 | Headworks | CG | 60" x 36" | 708.0' | 704.00 | 36" (S) | FE | Yoke Mounted HW |
| SG-102 | Headworks | CG | 36" x 30" | 708.0' | 704.00 | 30" (S) | FE | Yoke Mounted HW |
| SG-103 | Headworks | CG | 60" x 36" | 708.0' | 703.75 | 36" (S) | FE | Yoke Mounted HW |
| SG-104 | Headworks | CG | 36" x 30" | 708.0' | 703.75 | 30" (S) | FE | Hand Gate |
| SG-105 | Headworks | CG | 30" x 36" | 708.0' | 703.25 | 36" (S) | FE | Hand Gate |
| SG-106 | Headworks | CG | 60" x 36" | 708.0' | 703.25 | 36" (S) | FE | Yoke Mounted HW |
| MSG-201 | SBR Flow Splitter | CG | 24" x 24" | 708.0' | 697.00' | 60" (S) | FE | Yoke Mounted – Electric Actuator* |
| MSG-202 | SBR Flow Splitter | CG | 24" x 24" | 708.0' | 697.00' | 60" (S) | FE | Yoke Mounted – Electric Actuator* |
| MSG-203 | SBR Flow Splitter | CG | 24" x 24" | 708.0' | 697.00' | 60" (S) | FE | Yoke Mounted – Electric Actuator* |
| MSG-204 | SBR Flow Splitter | CG | 24" x 24" | 708.0' | 697.00' | 60" (S) | FE | Yoke Mounted – Electric Actuator* |
| SG-200 | Post EQ 2 Pump By-Pass | SG | 8" x 8" | 696.83' | 677.00' | 17' (S), 10' (U) | CW | Pedestal -Hand Wheel |
| SG-400 | UV #3/#4 Influent | CW | 18" Dia. | 681.00' | 675.00 | 6' (U) | CW | SN w/ Non-Rising Stem & 2:1 Gear Box & Tee Wrench |
| MSG- 401 | UV #3 Influent | CG | 28" x 30" | 681.00' | 677.77' | 30" (S) | FE | Yoke Mounted Electric Actuator ** |
| MSG-402 | UV #4 Influent | CG | 28" x 30" | 681.00' | 677.77' | 30" (S) | FE | Yoke Mounted Electric Actuator ** |
| SG-403 | UV #3/4 Drain to UV #1/2 | CG | 8" Dia. | 681.00' | 677.77' | 6' (S or U) | CW | SN w/ Non-Rising Stem, & Tee Wrench |
| SG-404 | UV #1/#2 Influent | CG | 24" Dia. | 681.00' | 675.00' | 6' (U) | CW | SN w/ Non-Rising Stem, 2:1 Gearbox Box & Tee Wrench |
| WG-100 | Influent Flow Splitter | WG | 40" x 24" | 712.00' | 708.38' Open 710.00' Closed | 18" (S) | CW | Yoke Mounted – Handwheel |
| WG-101 | Influent Flow Splitter | WG | 40" x 24" | 712.00' | 708.38' Open 710.00' Closed | 24" (S) | CW | Yoke Mounted - Handwheel |
| WG-200 | Post EQ #2 | WG | 36" x 36" | 696.83' | 691.0' Open 694.0' Closed | 24" (S) | CW | Yoke Mounted - Handwheel |
| SG-800 | Stromwater Pond | SG | 12" Dia. | 663.5' | 659.95' | 3.6 (S) | CW | Yoke Mounted - Handwheel |

* Note: Channel gate actuators at the SBR Flow Splitter are to be supplied and coordinated by the SBR equipment supplier.
Channel gate actuators at UV #3 and UV #4 Influent Channels are to be supplied and coordinated by the UV Equipment supplier.

| Abbreviations: | | Actuator Types |
|---|---|---|
| CG Channel Gate | WG Weir Gate | HW Hand Wheel Operator |
| CSG Channel Stop Gate | CW Concrete Wall Mounted | HC Hand Crank |
| SG Sluice Gate | FE Frame Embedded | SN Square Nut |

END OF SECTION

SECTION 40 20 00
PROCESS PIPING, FITTINGS, VALVES AND ACCESSORIES

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section includes the specifications for furnishing and installation of the following:
   1. Pipe
   2. Valves
   3. Fittings
   4. Accessories.

B. Related Sections:

   1. Section 01 33 01 – Submittal Procedures EPMS
   2. Section 09 90 00 – Painting and Coating
   3. Section 33 34 00 – Sanitary Sewer Force Main
   4. Section 31 23 16.13 – Trenching
   5. Section 33 05 19 – Pressure Piping Tied Joint Restraint Systems

### 1.2 REFERENCES

A. Work shall conform to the following codes and standards:
   1. North Carolina State Energy Code
   2. North Carolina State Heating, Ventilating and Air Conditioning Code
   3. North Carolina State Plumbing Code
   4. Local codes and ordinances
   5. Standard Gas Code of the Southern Building Code Congress International, Inc.
   6. Southern Standard Building code
   6. OSHA
   7. Industrial Risk Insurers (IRI) Criteria
   8. Underwriters Laboratories (UL) Criteria
   9. American Society for Testing Material (ASTM)
   10. American National Standards Institute (ANSI)
   11. The American Society of Mechanical Engineers (ASME)
   12. The American Water Works Association (AWWA)
   13. The Institute of Electrical and Electronic Engineers (IEEE)
   14. The American Institute of Steel Construction (AISC)
   15. The National Electrical Manufacturers Association (NEMA)

B. The following standards govern this work:
   ANSl B31.1: Power Piping
   ANSl B31.3: Chemical Plant and Petroleum Refinery Piping
   ANSl/WWA C600: Standard for Installation of Cast Iron Water Mains
   AWWA C6Ol: Standard for Disinfection Water Mains

## 1.3 DESIGN REQUIREMENTS

A. All apparatus, equipment, piping and ductwork shall fit into the space provided in the building or within the property and shall be installed at such time and in such manner as to avoid damage to the building structure or property and as required by the job progress. Equipment, apparatus, and accessories requiring normal servicing or maintenance shall be made readily accessible.

B. Piping equipment and ductwork shall be routed as shown on the Drawings. All piping and ductwork not specifically located on the Drawings shall be routed as close as possible to walls, ceilings, columns, etc., so as to take up a minimal amount of space. All offsets, fittings, etc., required to accomplish the complete operational system shall be furnished and installed at no additional cost. Equipment shall be located as shown on the Drawings except where interference exist. Decisions as to which item is to be relocated shall be made by the ENGINEER.

C. Cooperation with Other Trades: The CONTRACTOR stall cooperates and coordinate with the OWNER and other trades in the scheduling of work, moving of material, delivery and location of anchor bolts, sleeves, motors, starters, and other equipment and materials.

D. The drawings accompanying these Specifications are generally diagrammatic and do not show all details such as hangers, couplings, bolts, nuts, connections, etc. required for the completed work. The CONTRACTOR shall be responsible for arranging his work so as to avoid interference with doors, windows, structural members, equipment, lights, and/or other systems. It shall be assumed that the CONTRACTOR is thoroughly competent and familiar with the class of work involved and has familiarized himself with the job conditions and its detailed requirements. The CONTRACTOR shall coordinate the work of the different trades so that interference will be avoided as far as possible, but in case interference develops the ENGINEER shall decide which equipment, ducts, piping, etc. must be relocated, regardless of status of installation. Any necessary changes shall be made with no additional cost. CONTRACTOR shall carefully lay out the work and be responsible for all locations, grades and levels. He shall check all dimensions before starting any work and report any discrepancies or interference to the ENGINEER for correction.

## 1.4 PERFORMANCE REQUIREMENTS

A. All equipment, materials, and accessories shall be new and of the best quality and grade specified and shall be in strict accordance with the Specifications and Drawings. All mechanical equipment shall be the product of reputable manufacturers and equipment shall have the manufacturer's name, address and model number on a nameplate securely affixed in a conspicuous place.

B. Certain manufacturers' product names, figure numbers, etc., are used in these contract documents to establish qualities of the materials, workmanship, and performance required. In such cases, the item mentioned is a product known to the ENGINEER that offers the design, materials, workmanship, and performance required. Proposals and

contract shall be based on the use of named products unless approved by the ENGINEER as an equal.

C. CONTRACTOR may submit with his proposal alternate products, which can be considered by the ENGINEER as being the full equal of and similar in all respects to those mentioned. These will be reviewed for use if upon submission, descriptive and technical data sufficient to demonstrate quality beyond question is provided. The burden of proof in questions of equality lies with the CONTRACTOR, and sole judge of equality shall be the ENGINEER. Proposal for alternate materials shall include complete data demonstrating cost reduction to be passed on to the OWNER.

D. Any and all changes to the work, the design, the work of other trades or contractors, brought about by the allowance of a substitution shall be the responsibility of the CONTRACTOR requesting that substitution.

1.5 SUBMITTALS

A. Section 01 33 01 Submittal Procedures.

B. The CONTRACTOR shall prepare shop drawings of piping, H.V.A.C. Systems, ductwork, fire protection systems, and equipment locations based on approved equipment and shall submit those for approval. Shop drawings shall show: location and weights of all roof mounted equipment, roof openings, pads, sleeves, power connections and shall be of a scale no less than the Contract Drawings.

C. CONTRACTOR shall also submit shop drawings prepared by the manufacturers of all of the following:
1. All specialty items, misc. equipment and items with equipment numbers
2. Valves
3. Control equipment and/or control systems
4. Plumbing, fixtures, equipment, trim and accessories

D. Shop drawings submitted by the CONTRACTOR shall be checked for accuracy, coordinated with other work and corrected if necessary before submission to the ENGINEER.

E. Review of shop drawings or equipment schedules by the ENGINEER shall not relieve the CONTRACTOR from responsibility for errors of any kind on his part or responsibility for meeting the requirements of the Contract Documents.

F. Each print and shop drawing submitted shall bear on its face the approval stamp of the CONTRACTOR indicating that the submission has been thoroughly checked by the CONTRACTOR.

G. All shop drawings requiring approval by any code enforcement authority and/or the OWNER's underwriter, shall bear the required approval stamp to the submittal.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Furnish to the ENGINEER not later than 30 days before start-up three (3) separate sets of bound instruction books together with spare parts lists covering each item of equipment and operation of each system in detail.

1.7 QUALITY ASSURANCE

A. All permits, assessments, taxes, fees, licenses, etc., necessary for the installation of the work, shall be obtained and paid for as required in Special and General Conditions. CONTRACTOR shall deliver to the OWNER, without charge, all certificates of inspection issued by the authorities having jurisdiction.

B. All work covered by these specifications shall conform to all applicable federal, state and local laws, ordinances, and regulations. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations having jurisdiction in Denver, North Carolina, Lincoln County; as well as the requirements of the Owner's Underwriter, and the current edition of the North Carolina Building Code.

C. CONTRACTOR shall notify the ENGINEER in writing of any instances on the Contract Documents that are in conflict with any of the aforementioned authorities prior to accepting award of the contract, so that any required changes can be accomplished.

D. All materials and work covered by these Specifications shall conform to the applicable standards of Industrial Risk Insurers and shall be submitted to and be acceptable to the inspection department having jurisdiction. Approval and acceptability shall be documented in triplicate prior to beginning work on any covered portion of the work.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. The CONTRACTOR shall provide and pay for all freight, express, trucking transportation, cartage, storage and handling of equipment and Materials. Materials, etc., shall be delivered to the job site in ample quantities to insure uninterrupted progress of the work. Extra handling, shipping, and storage expenses incurred in expediting materials, etc., to prevent interruption of the overall job progress shall be paid for the CONTRACTOR.

1.10 SPECIAL SERVICES

A. The CONTRACTOR shall, with the assistance of his subcontractors and/or equipment suppliers, instruct OWNER's operating personnel in the safe and correct procedure for

normal and emergency starting and stopping, cleaning, checking, logging, lubricating, periodic testing, trouble shooting and normal operation of all equipment and/or Systems. The instructions shall be in the form of qualified personnel of the CONTRACTOR and his subcontractors reviewing the installation with the OWNER's operating personnel as well as covering all operating, maintenance, and similar literature provided as specified herein.

B. As herein specified, and/or as required, the CONTRACTOR shall provide any necessary specialized services, such as accredited direct factory representatives of manufacturers as may be required for supervision or erection and/or adjusting and placing equipment in operation.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 PIPING AND JOINTS

A. Provide the types of pipe for systems as indicated on the drawings.

2.2.1 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to the requirements of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. Minimum thickness Classifications for ductile iron pipe for pipe shall be as follows unless otherwise noted:
   1. 12-inch and smaller - Pressure Class 350
   2. 14-inch to 24-inch - Pressure Class 250
   3. 30-inch and larger - Pressure Class 150

B. Ductile iron piping and fittings for wastewater service shall be PROTECTO 401 Ceramic Epoxy lined unless otherwise noted.

C. Ductile iron pipe used for air service shall be unlined.

D. Provide manufacturer's standard bituminous coating on outside of all ductile iron pipe and fittings for buried applications. Ductile iron pipe within pump station dry wells shall be primed and painted.

2.2.2 STAINLESS STEEL PIPE

A. Stainless steel pipe shall be annealed, pickled and passivated conforming to ASTM A312, TP304 for screwed joints and TP304L for welded joints. Pipe shall be as follows:
   1. 1-1/2 inches and smaller shall be Schedule 40S, seamless
   2. 2 inches and larger shall be 10S unless otherwise noted.

B. Joints shall be as follows:
   1. ¾-inch and smaller: Screwed
   2. 1 inch to 1-1/2 inch: Socket welded
   3. 2 inch an larger: Butt-welded or flanged with 304 SS bolts and copper-silicon hex nuts.

2.2.3 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPE

A. All CPVC Schedule 40 and schedule 80 pipe shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a minimum Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the Quality Assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be produced in the USA using domestic materials, by an ISO 9001 certified manufacturer, and shall be stored indoors after production, at the manufacturing site, until shipped from factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications. The pipe shall have a Flame Spread rating < 25 and a Smoke Development rating < 50 when tested and listed for Surface Burning Characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent. Unless otherwise specified, pipe shall be Schedule 80. All pipes to be threaded shall be Schedule 80 or thicker.

B. Joints shall be solvent welded, screwed or flanged. All fittings shall be manufactured by the same company that manufactures the pipe and rated for the same working pressure as the pipe or higher.

2.3 FITTINGS

A. Use fittings of same size as pipe they serve. Reducers are not permitted to facilitate on off-size fitting. Reducing bushings are also prohibited. Reduction in piping size will be made by reducing fittings. Fittings shall be lined and coated as specified for pipe they serve. Fittings for use with galvanized pipe shall be galvanized in accordance with ASTM A 153.

B. Dissimilar Metals. Make joints between copper and steel pipe or equipment using insulating unions such as Crane Company No. 1259, EPCO as manufactured by EPCO Sales, Inc.; or approved equal.

C. Screwed Fittings. Fittings for steel pipe with threaded joints shall be 150-pound malleable iron screwed fittings in accordance with ANSI B16.3. Provide pipe with American Standard taper pipe threads. Unions shall be 150-pound malleable iron, ground-joint unions with bronze seat. Unions for PVC pipe shall be PVC with Buna-N 0-rings.

D. Push-on Fittings. Fittings for use with push-on joint ductile or cast iron pipe shall be cast iron or ductile iron fittings conforming to AWMA Cll0 with joints conforming to AWWA Clll, unless otherwise specified. All fittings shall be pressure rated at 250 psig.

E. Welding Fittings. Welding fittings for use with welded steel pipe shall be forged steel fittings in accordance with ANSI B16.9, standard weight.

F. Flanged Fittings. Fittings for use with flanged joints on ductile or cast iron pipe or on steel pipe shall be cast iron or ductile iron fittings conforming to ANSI B16.1 or AWWA Cll0. Flanges shall be faced and drilled in accordance with ANSI B16.1, Class 125. All fittings shall be pressure rated at 250 psig.

G. Flanges for ductile or cast-iron pipe shall be ductile or cast iron flanges screwed on threaded ends of the pipe. Flanges shall conform to ANSI B16.1, Class 125. Screwed-on flanges shall be attached to the pipe in the shop; attachment, aligning and facing shall conform to AWWA C115. All flanged pipe, including flange-by-plain end pieces, shall be hydrostatically tested to 125 psig and certification furnished to the Engineer.

H. Welding flanges for steel pipe shall be steel flanges in accordance with AWWA C207, Class D, or welding slip-on flanges conforming to ANSI B16.5, Class 150, with flat face. Use welding neck type flanges on all fittings.

I. Flanges for stainless steel pipe shall be forged stainless steel, ASTM A182, Grade F304L, slip-on or welding neck type, faced and drilled 150-pound, 1/16-inch raised face, ANSI B16.5 standard. Bolting shall be Type 304 stainless steel bolts (UNC Am. Std.), ASTM A320, Grade B8, with copper-silicon hex nuts (UNC American Standard) ASTM B98, Grade A hard.

J. Ductile Iron Wall Pipe and Wall Sleeves shall be use on all piping passing through concrete walls. Wall pipes and sleeves shall be fabricated of special thickness Class 53 Ductile Iron Pipe with welded-on thrust collars fabricated from steel. Pipes shall terminate in flanged, mechanical joints or plain ends based upon application as shown on drawings.

## 2.4 COUPLINGS

### 2.4.1 Flexible Couplings.

A. Flexible couplings shall be installed where shown on the drawings or elsewhere where allowed by the Engineer for the Contractor's convenience. Flexible couplings shall be galvanized when on galvanized pipe or on pipe which is epoxy or cement lined, or when underground. Gaskets for flexible couplings shall be neoprene or Buna-N.

B. For ductile iron pipe, sleeve-type flexible couplings shall be Rockwell Type 430 series, or approved equal. For steel pipe, sleeve-type flexible couplings shall be Rockwell Type 411, or equal.

C. Flanged adapter couplings for ductile iron pipe shall be Rockwell 912, or equal; flanged adapter couplings for steel pipe shall be Rockwell Type 913 or approved equal. Flanged adapter couplings shall have not less than two anchor studs each, unless specifically noted otherwise on the drawings.

D. Where flexible couplings are installed underground, Type 316 stainless steel bolts shall

be used. The entire coupling shall be given a 20-mil coat of T. C. Mastic as manufactured by the Tape Coat Company, Inc., Bitumastic No. 50 as manufactured by Koppers Company, Inc., or approved equal.

E. Expansion Joints. Single end or double end expansion joints shall be installed where shown on the drawings. Expansion joints shall be carbon steel ASTM A283 or ASTM A285. Slip pipes shall be chrome-plated on a machined surface. Gaskets shall be alternate square rings of lubricant impregnated flax and Grade 60 rubber. Adjustable limit rods shall be provided. Limit rods and body studs, bolts and nuts shall be constructed of carbon steel ASTM A307 or A242.

F. Expansion joints shall be equipped with retaining rings, rods and all other accessories as recommended by manufacturer with filled arch.

## 2.5 VALVES

### 2.5.1 Butterfly Valves

A. Butterfly valves and operators shall conform to AWWA Standard for Rubber-Seated Butterfly Valves, AWWA C504, except as modified or supplemented herein.

B. Butterfly valves may be short body or long body, as determined by their location in the pipe system. Short body valves shall be used only in locations where the disc will not interfere with adjacent pipe fittings, valves or equipment.

C. The use of special ends adapted for use with grooved end pipe and couplings may be permitted, subject to review of each location by the Engineer.

D. Valve Construction

1. Valves and operators shall be designed for a flow through the valve corresponding to a pipeline velocity of 16 feet per second with the vane in the position of maximum coefficient of torque or for the maximum torque that may occur under the specified operating conditions of flow, pressure, valve angle, including seating, unseating, and bearing torque, whichever is greater; method of determining torque shall be in accordance with Appendix A of AWWA C504.
2. Valves shall be of the AWWA class indicated in these specifications. All manually operated valves for open-close service 70 inches in size and smaller shall be Class 150B.
3. Discs for valves 12 inches in size and smaller shall be ASTM A 435, Type 1 (Ni-Resist), fiberglass-reinforced thermoplastic (Noryl), or ductile iron with Type 304 or Type 316 stainless steel mating edge, discs for valves 14 inches and larger shall be Type 304 or 316 stainless steel mating edge on either cast iron or ductile iron disc. Method of attaching edge to disc shall be subject to review by the Engineer.
4. The valve shaft, and the keys, dowel pins, or taper pins used for attaching the valve shaft to the valve disc shall be Type 304 or 316 stainless steel. All portions of the shaft bearings shall be stainless steel, bronze, nylon, or fiberglass and Teflon in accordance with AWWA C504. Seats in valves for water or sewage service shall be Buna-N or neoprene.

5. All nuts and screws used with clamps and discs for rubber seats shall be securely held from loosening from vibration or cavitations effects.
6. Valve disc shall seat in a position of 90 degrees to the pipe axis and shall rotate 90 degrees between full-open and tight-closed position. Valves shall be installed with valve shafts horizontal.

2.5.2 Swing Check Valves

A. Swing check valves shall be manufactured from gray cast iron meeting or exceeding ASTM A126 Grade B. Valves to comply with AWWA C508, latest revision, and include the following features.

B. Valves shall be designed to permit a clear waterway opening for utilization of pipeline cleaning apparatus if necessary. Valve disc and clapper assembly shall also be removable from valve body with valve remaining in pipeline. Disassembly of valve internals to require no special tools other than standard socket wrenches.

C. Valve clapper arm and disc assembly to be provided with corrosion resistant bearings to reduce wear and prevent galling action between the two parts. Clapper arm shall be made of ductile iron material conforming to ASTM A536 Grade 65-45-12 for extra strength or high strength bronze. The disc shall not contact the body when the valve is in the full open position.

D. Check valve shafts to be 316 stainless steel with corrosion resistant bearings provided at each end. Shaft and bearings are to be completely replaceable, if necessary, with valve remaining in pipeline. If valve shaft is extended outside the body, a double o-ring seal fully contained within the shaft bearing shall be provided. There shall be a grease fitting for lubrication between the o-rings for double protection against foreign matter reaching bearing surfaces. If valve shaft is extended with external lever and weight/spring, it shall be possible to move the lever and weight/spring to opposite side of valve in the field should piping clearances require this modification. Different lever orientation shall be possible in the field in increments of 45 deg. for full 360 deg. circle without shaft modifications or extra drilling.

E. Valve seating surfaces shall be bronze. The mating seat in the valve body shall be field removable and replaceable, if necessary, without removing valve from pipeline. Valve design shall be such that the valve remains in the closed position when installed in horizontal pipeline under no-flow condition.

F. Packing, O-Rings and other rubber components shall be Buna-N for application temperatures of 180 degrees F (82 degrees C) and below.

G. Valves 6” and larger shall be provided with adjustable air cushion chambers.

H. Valves shall be provided with an internal and external epoxy coating conforming to ANSI/AWWA C550.

2.5.3 Wafer Silent Check Valves

A. Wafer silent shall be supplied by a manufacturer with experience manufacturing silent check valves for a period of at least ten years and shall, at the request of the Engineer, provide a list of installations involving equipment of similar size and application.

B. Wafer silent check valves shall have ASTM A126 Class B cast iron body suitable for installation between two pipe flanges.

C. Valves up to 6 inch size shall be capable of installation between ANSI Class 125, 150, 250 or 300 flanges with full face gaskets. Sizes 8 inch and 10 inch shall be capable of installation only between ANSI Class 125 or 150 flanges with full face gaskets. Flow area through the valve shall be no less than the nominal valve size.

D. Wafer style valves shall have concave, double-guided plug and seat of ASTM B62 bronze with stainless steel internal spring and a renewable resilient Buna-N seat retained in a dovetail groove with a metal-to-metal backup.

E. The internal spring shall assist closure by exerting a force equivalent to 1/2 PSI in the closed position and be fully compressed at a flow velocity of 4 feet per second.

F. The valve shall be designed to open when the inlet pressure exceeds the outlet pressure by 1/2 PSI and to close without slam under all closure conditions to positively prevent the return of water when the inlet pressure decreases below the outlet pressure.

2.5.4 Gate Valves

A. Gate valves 2-1/2 inches in size and smaller shall be 125 psig SWP, bronze, rising stem, single wedge disc gate valves with screwed ends.

B. Gate valves 3 inches and larger shall conform to AWWA C509 and shall be 200 psig WWP, iron body, resilient seats, OS&Y gate valves with ANSI flanged ends, coating conforming to AWWA C550; interior/exterior.

C. Gate valves shall open counterclockwise unless otherwise noted.

2.5.5 Plug Valves

A. Plug valves 3 inches to 12 inches:
   1. Valves shall be nonlubricated type 175 psig WP, drip-tight shutoff with pressure from either direction.
   2. Valves shall have a cast iron body with flanged ends per ASME B16.1 or grooved ends in accordance with AWWA C606 for rigid joints for buried service mechanical joint ends, unless otherwise noted.
   3. Plug shall be cast iron with round or rectangular port of no less than 80 percent of the connecting pipe area and coated with Buna-N.
   4. Seats shall be welded nickel with stem bearings lubricated stainless steel or bronze, stem seal multiple V-rings or U-cups with O-rings of nitrile rubber, grit

seals on both upper and lower bearings.

5. For buried service, provide external epoxy coating.
6. Operators:
   a. 3 inch to 4 inch valves - Wrench lever manual
   b. 6 inch to 12 inch valves - Totally enclosed or as indicated otherwise on the Drawings, geared, manual
      operator with handwheel, 2-inch nut or chain wheel. Operator to be sized for 1.5 times the maximum operating shutoff pressure differential for direct and reverse pressure, whichever is higher.
   c. Buried service - Provide completely sealed operator filled with heavy lubricant and 2-inch nut with stem extension within 6” of ground level.

2.5.6 Ball Valves (Plastic)

Plastic ball valves shall have polyvinyl chloride (PVC) body and ball, ball seats of Teflon, and stem and body seals of viton. Valves shall be suitable for a working pressure of 150 psig, shall have true union type end connection, and shall be furnished with wrench-type tee handles.

2.5.7 Air/Vacuum Valves

A. Acceptable Manufacturer: A.R.I. per Owner standard.

2.5.8 Surge Relief Valves

B. Construction: Surge Relief Valve shall consist of a main valve assembly and a pilot control system, completely assembled and tested as a unit and ready for field installation.

C. Main Valve:
   1. Main valve body shall be angle or globe style of high strength cast iron conforming to ASTM A126 Class B with integral flanges, faced and drilled per ANSI B16.1 Class 125 as shown on plans. The valve shall be "full-ported" with a flow area through the valve no less than the area of its nominal pipe size when the valve is fully open.
   2. The main valve shall operate on the differential piston principle such that the area on the underside of the piston is no less than the pipe area and the area on the upper surface is greater than that of the underside. There shall be no diaphragms or springs in the main valve.
   3. The valve piston shall be guided on its outside diameter by long stationary vee-ports located downstream of the seat to minimize the consequences of throttling. All throttling shall be by the vee-ports and not by the seat itself. All internal guiding and sealing surfaces shall be bronze.
      a. A replaceable seat ring of Buna-N or other suitable material shall be mechanically attached to the piston by means of a bronze follower ring and stainless-steel fasteners.
      b. The piston shall be sealed by Buna-N or other resilient material suitable for the operating pressures and fluid type.
      c. A position indicator rod shall be provided, mechanically attached to the piston, and passing through the valve cover. The indicator rod shall be sealed by a compression type, Teflon packing.

d. The valve shall be fully capable of operating in any position without the need of springs and shall not incorporate stems, stem guides or spokes in the waterway.

e. The main valve shall be serviceable in the line through a single flanged cover which provides easy access to all internal components. Globe style valve shall have an integral bottom pad or feet for the valve to rest on a pier.

D. Controls: Provide a system of hydraulic controls to enable the valve to perform the function(s) listed below.

1. Provide a direct-acting, diaphragm-operated, spring-loaded bronze relief pilot. The pilot spring shall be factory set at the desired relief pressure, but easily field adjustable from near zero to 10% above the factory setting. The relief pilot shall be factory set at the pressure as noted on the drawings.
2. Provide an adjustable closing speed control, Y-strainer with stainless steel screen, pilot isolating valves and all non-corrosive stainless steel pilot piping. Pilot system shall be suitable for the working pressure.

E. Shop Finishing

1. Exterior ferrous surfaces shall be painted with (1) coat of manufacturer's standard primer.
2. Interior, submerged ferrous surfaces shall be painted with 2 coat(s) of NSF-61 approved epoxy paint.

F. Function

1. The pressure relief valve shall remain tightly closed whenever system (inlet) pressure is below the setting of the relief pilot.
2. The pressure relief valve shall quickly open when the system pressure exceeds the setting of the relief pilot.
   a. The pressure relief valve shall remain open as long as the system pressure equals or exceeds the setting of the relief pilot.
   b. The pressure relief valve shall close slowly when the system pressure falls below the setting of the relief pilot. The speed of valve closure shall be adjustable.

2.5.9 Hose Bibbs

A. Standard Hose Bibbs – shall be angle-hose valves of bronze construction suitable for 200 psi minimum working pressure. Valves shall have a renewable Teflon or resilient disc and shall be furnished with a 3/4 –inch male hose outlet connection. Body and bonnet shall be ASTM B 62 bronze. Valves shall be furnished with a suitable cap and chain. Inlet connection shall be threaded per ANSI B2.1.

B. Non-Freeze Hose Bibbs – shall be galvanized steel construction with lever handles, adjustable link for lever lock-in tension, rod guide, flow find and lock, Teflon – impregnated packing, large cushion type seal, 1" inlet and ¾" x 1" hose adaptor and designed for a minimum 3' burial depth by Murdock Hydrant or equal.

## 2.6 MANUAL VALVE OPERATORS

A. Unless otherwise shown or Operator specified, all valves shall be furnished with manual operators as follows:

| | |
|---|---|
| 1. Gate Valves | |
| a. Buried | Extension stem to within 6" of ground elevation and valve box with standard operating nut and tee handle. |
| b. Submerged or Located in Deep Vault | Extension stem with floor stand and handwheel operator on tee handle in accessible vaults. |
| c. Exposed | |
| • Less then 7 feet above working surface | Handwheel operator |
| • More than 7 feet above working surface | Chain wheel operator |
| 2. Globe Valves, All | Handwheel operator |
| 3. Butterfly and Plug Valves | |
| a. Buried | Standard operating nut with extension stem and valve box (4 inches and smaller); or rotary manual operator with extension stem and valve box and standard operating nut (larger than 4 inches) |
| b. Submerged or Located in Deep Vault | Rotary manual operator with extension stem and floor-stand with handwheel (all sizes) |
| c. Exposed | |
| • Less than 7 feet Above working surface | Level operator (4 inches and smaller) or rotary manual operator and handwheel (larger than 4 inches) |
| • More than 7 feet above | Rotary manual operator working surface and chainwheel (all sizes) |

B. Operating nuts for buried or submerged valves shall be standard 2-inch square nuts and shall conform to AWWA C500, Section 19. Extension stems, valve boxes, and stem guides shall be furnished where shown, specified, or required for proper operation.

C. Hand lever operators shall have heavy-duty, cast iron bracket, cast iron latching lever, and self-lubrication bushings and shall be capable of securing the valve at the fully open and fully closed position and a minimum of 5 intermediate positions. Lever operators shall be installed so that the lever is parallel with the axis of the pipe in which the valve is installed when the valve is fully open.

D. Rotary manual operators for aboveground services shall be of the worm and worm gear or of the traveling nut type. Rotary operators shall have heavy-duty, weatherproof cast iron or steel housing with gasketed, removable cover and shall be equipped with a

mechanical dial or slot type position indicator and a suitable handwheel. Manual operators shall be totally enclosed and sealed to prevent the entrance of rain, dirt, and corrosive atmospheres. Traveling nut operators shall have a grease-lubricated alloy steel screw stem, brass nut, and self-lubricated bronze bushings. Worm gear operators shall have hardened, grease-lubricated alloy steel worms and bronze worm gears. All exterior bolts and fasteners shall be bronze or stainless steel for corrosion resistance. The valve shall open with counterclockwise rotation of the handwheel.

E. Manual rotary operators for buried or submerged service shall conform with the requirements of item D above except the operator shall be totally enclosed and completely sealed to prevent the entrance of water and dirt. Buried or submerged operators shall be finished on the outside with bituminous or other approved coating. Rotary operators for buried or submerged service shall be capable of withstanding 300 foot/pounds of torque on the operating nut or handwheel. A corrosion resistant, dial-type valve position indictor shall be provided at the operating nut on the extension stem of buried operators to provide a remote indication of valve position.

F. Chain wheel operators shall be of heavy cast iron construction and shall be equipped with chain guide and looped, flexible, operating chain. Chain shall be heavily galvanized or cadimium plated and shall extend to within 60 inches of the floor.

G. All manual rotary and lever operators shall be capable of seating or unseating the valve disc under the most adverse conditions in the particular application with not more than an 80-pound pull on the handwheel or lever. Valve operators shall be capable of holding the valve in any position between fully open and fully closed without creeping or fluttering. Operators shall be provided with adjustable, mechanical, stop-limiting devises to prevent over-travel of the vale disc in the open and closed positions. Manual rotary and lever operators shall comply with all applicable requirements of AWWA C504, Sections 11.1, 11.2, and 11.3.

## 2.7 COMPONENTS

A. Bolts And Nuts - Bolts and nuts shall meet the dimensional requirements of ANSI B16.1 for Class 125 or ANSI B16.2 for Class 250. Bolts shall be ASTM F593 316 Stainless Steel and have standard hexagonal heads and nuts with ASTM F594 304 Stainless Steel, hexagonal nuts. An anti-seize compound shall be used during assembly.

B. Gaskets – Gaskets for flanged pipe are to be Toruseal® or equal, 1/8” Styrene Butadiene (SBR) rubber conforming to ANSI/AWWA C111/21.11 for Ductile Iron Pipe and ASTM F-477 for plastic pipe.

## 2.8 PRESSURE SENSORS & GAUGES

A. Pressure Gauge Isolation Rings – Pressure gauges shall be protected by an isolation ring.

C. All pressure gauges shall be selected so that under normal operating conditions, the pointers will be approximately vertical and at midpoints of scales. Gauges shall include 304 stainless steel case, EPDM O-rings, polycarbonate window, glycerin filling, ¼-inch stainless steel connection and stainless steel inlet snubber valve.

D. The CONTRACTOR shall submit for approval a list of gauges and sensors proposed for each point indicated on the Drawings and specified, and this list shall give manufacturers catalog number, gauge size, gauge range, and accessories to be provided.

E. Each gauge shall be equipped with a gate valve. Each pressure connection point for gauges located more than 2 feet from point of pressure connection shall be provided with an additional cock.

## 2.9 EXTENSION STEMS

A. Extension stems shall be solid steel not smaller than the stem of the valve or galvanized steel pipe having an inside diameter not smaller than the outside diameter of the valve or valve operator stem. Extension stems shall connect to the valve by a flexible socket coupling. All couplings shall be pinned, keyed, or socket type.

B. Each extension stems for buried valves shall extend to within 6 inches of the top of the valve box or floor box and shall be provided with spacers which will center the stem in the valve box. A standard wrench nut shall be provided on the top of the extension stem. Extension stems for raising stem valves shall be stainless steel with bronze or stainless steel sleeves. Sleeves shall be of sufficient length and location to extend through each stem guide throughout the full vertical stem travel. Extension stems for submerged service shall be stainless steel or bronze.

C. Stem guides shall be bronze-bushed, cast iron construction adjustable in 2 directions. Stem guides shall be installed so the unsupported length of the extension stem does not exceed 10 feet or an L/r of 200.

D. Bevel gear extension stems shall be furnished where it is impractical to locate the floorstand directly over the valve. Such stems shall include a sufficient number of bearings to permit easy operation of the valves.

## 2.10 VALVE BOXES

A. Provide buried valves with cast iron valve boxes of the extension sleeve type suitable for depth of cover over pipe as shown. Furnish valve boxes at least 5 inches in diameter, 3/16 inch thick, with suitable cast iron bases and covers. Coat all parts of valve boxes, bases and covers by dipping in hot bituminous varnish. Provide Mueller H-10360, two-piece, screw type with base, top section and cover as required, or approved equal. Provide extension stem for all buried valves terminating in a standard 2-inch-square AWWA nut within 6 inches of valve box cover.

B. Each valve box shall be provided with a valve-box-alignment device (VBAD) to prevent shifting of box and maintain alignment of operating nut. The VBAD shall be colored white HDPE construction and non-load bearing upon assembly. The VBAD shall be furnished in multiple pieces with a snap-assembly loosely to valve/gear stem below the operating nut. The VBAD shall be the a Boxlok as manufactured by EMMA Sales, LLC or approved equal.

2.11 PIPE SUPPORTS

A. General: All above ground piping shall be adequately supported to prevent sagging, vibration and movement per ANSI/MSS SP-58-2018: Pipe Hangers and Supports-Materials, Design, Manufacturer, Selection, Application and Installation guidelines. Piping support may be from above with hangers or below using vertical support. Maximum pipe support spacing for pipes shall not exceed 10 feet on center without documentation that bending, and shear stress does not exceed 1500 psi and deflection between hangers will not to exceed 0.1-inch.

B. Small Diameter Pipes (3" and below): Provide standard Unistrut type stainless steel framing members and appurtenances for pipe support. Multi-A-Frame and Power-Strut type pipe support systems also are acceptable. All such members and appurtenances shall be 304 stainless steel.

C. Large Diameter Pipes (4" and above): Provide standard adjustable pipe saddle supports with U-bolt of 304 stainless-steel construction and insulation between saddle and pipe for dissimilar metals.

2.11 PIPE MARKERS

A. Pipe markers shall be compliant with ASME (ANSI) A13.1-2007, color standard.

B. Pipe markers shall be similar or equal to Brady Perma-Code Pipe Markers, System 2, consisting of pipe marker, arrows and 1-1/2-inch wide (minimum) branding tape. Material shall be similar or equal to Brady B-350, 35 ounces per inch, for all indoor applications and Brady B-946G, 35 ounces per inch for all outdoor applications. Background colors of markers, arrows and tape shall be the same.

C. Pipe markers shall conform to ANSI "Scheme for Identification of Piping Systems".

3.0 EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the maximum access to various equipment parts for maintenance.

B. Do not cut or weaken any structural member.

C. Cut all pipes accurately to measurement determined at the site. After cutting pipe, ream it to remove burrs.

D. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make all changes in direction. Field bending and

mitering are prohibited. Make all connections to equipment using flanged joints or unions. Make reducing connections with reducing fittings only.

3.2 WELDING

A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.

B. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

C. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.

D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

E. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings, valves or equipment.

3.3 JOINTS AND JOINTING

A. Screwed Joints. Thoroughly ream the pipe to full inside diameter after cutting. Machine cut threads to ANSI taper pipe thread sizes. All-thread nipples are not permitted. Make screwed joints using suitable joint compound applied to male threads only; for screwed joints on PVC pipe, use Teflon tape.

B. Solvent-Weld Joints. Make solvent welded joints on PVC pipe in strict accordance with the manufacturer's instructions as to preparation, solvent and jointing.

C. Push-on Joints. Follow instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations. Lubricate joint surfaces with heavy vegetable soap solution immediately before joint is completed. Suitably bevel each spigot end to facilitate assembly.

3.4 FLANGED JOINTS

A. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle the vertical, horizontal or north-south center line. Do not exceed 3/64 inch per foot inclination of the flange face from true alignment.

B. Gaskets are to be 1/8 inch Styrene Butadiene (SBR) rubber. See addendum No. 01 for Paragraph 2.7.B change.

C. Use ANSI nuts and bolts galvanized or black to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent

unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.

D. Take care when attaching suction and discharge piping to pumping equipment to ensure that no stresses are transmitted to or imposed on pump suction and discharge flanges by connected piping. Install and permanently support piping to accurately match bolt holes and to provide uniform contact over the entire flange. In addition, leave pump connection piping free to move parallel to its longitudinal center line while bolts in pump connection flanges are tightened.

E. Provide maximum flexibility and ease of alignment correction by taking advantage of the slack between the flange bolts and bolt holes for slight angular rotation of connecting flanges. Assemble pump connecting piping with gaskets in place, with only a portion of the flange bolts (no fewer than four per joint) installed. After final alignment and before final bolting, test pump connections for applied piping stresses by loosening flange bolts which, if piping is properly installed, should result in no movement of piping relative to the pump, or opening of the pump connection joints.

F. Keep flange covers on equipment and shop-fabricated piping until ready to install in system.

## 3.5 OFFSETS AND FITTINGS

A. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.

B. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.

## 3.6 SECURING AND SUPPORTING

A. Support piping adequately to maintain line and grade, with due provision for expansion and contraction. Use approved, clevis-type, split-ring or trapeze-type hangers properly connected to structural members of the building. Do not support piping from other piping.

B. Use copper hangers with copper pipe. As an alternate, tape copper pipe at all points contacting steel hangers, structural members or sleeves. Use a dual wrap of polyvinyl tape.

C. Place hangers not more than 6 feet apart on 1/2-inch and 3/4-inch pipes, or 10 feet apart on larger pipes. Place hangers not more than 4 feet apart for all sizes of polyvinyl chloride pipe.

D. Support vertical risers with steel strap pipe clamps of approved design and size, properly supported at every floor. Support piping assemblies in chases adequately enough to be rigid and self-supporting before the chase is closed. Provide adequate structural support for piping penetrating chase walls to fixtures.

E. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section.

F. Perforated bar hangers, straps, wires or chains are not permitted.

## 3.8 ANCHORS

A. Provide anchors as indicated or required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe.

## 3.9 FIELD QUALITY CONTROL

A. Hydrostatic Tests. Prior to the completion of backfill, and while joints and fittings are still exposed, test new water lines hydrostatically. Conduct hydrostatic tests in the presence of the Engineer and in an approved manner. Apply test pressure not less than 200 psi or equal to normal static line pressure plus 50 psi whichever is greater, and maintain this pressure for a minimum of 2 hours. Do not permit line losses during the test to exceed 50 U.S. gallons per inch of pipe diameter per mile per day or a pressure variation by more than 5 psi at completion of hydrostatic test. Regardless of the rate of line loss, repair observed leaks. Replace faulty or defective materials at no change in the contract sum. Provide all pumps, gages, meters and other equipment necessary for performance of the tests.

## 3.10 PAINTING

A. Paint all metal surfaces above grade, interior or exterior, in accordance with Section 09 90 00, Painting and Coating.

## 3.11 PIPE MARKERS

A. Identify all exposed piping and piping in accessible chases or plenums with markers at every point of pipe entry or exit through a wall, roof or floor and at with symbols spaced at 8 foot intervals and pipe service TEXT applied at third points of all runs not to exceed 35 feet.

B. Apply markers where view is unobstructed.

## 3.12 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer’s field services.

## 3.13 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

END OF SECTION

SECTION 40 71 13.23
INSERTION-TYPE THERMAL MASS FLOW METER

PART 1 GENERAL

1.1 SUMMARY

A. Section includes: Specifications for Insertion-Type Thermal Mass Flow Meter and Flow Conditioner for monitoring air flow.

1.2 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals
B. Section 01 70 00 – Execution and Closeout Procedures
C. Section 43 12 19 – Positive Displacement Blower Assemblies
D. Section 44 46 10 – Sequencing Batch Reactor & Aerobic Digestion Equipment

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.4 QUALITY ASSURANCE

A. The insertion-type thermal mass flowmeter shall be Fluid Components International LLC or approved equal to fit the line size shown on the drawings.

B. The referenced manufacturer(s) is named to establish standards of quality. Equal products of other manufacturers complying with these specifications may be provided as an alternative for the Owner's consideration.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.6 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 INSERTION-TYPE THERMAL MASS FLOWMETER

A. Manufacturers:
   1. Fluid Components International LLC or Equal
   2. Substitutions: EJCDC® C-200 – 2013 Instructions to Bidders

B. Insertion-type thermal mass flow meter shall have the following features:
   1. Provide +/- 2% reading, +/- 0.5% full scale accuracy for repeatable flow measurement of air.

2. No moving parts with probe lengths suitable for installation into from 6-inch to 12-inch ductile iron pipe diameter as shown on the drawings via a ½ inch or ¾" NPT compression fitting.
3. Electronics housed in a rugged, IP67 rated enclosure with dual conduit ports for NPT threading.
4. Standard dual 4-20 mA analog output – one for flow rate and one for temperature.
5. Transmitter/electronics integrally mounted with the flow element (probe).
6. Flow sensing element with precision, platinum RTD in small diameter, equal mass, all-metal thermowells to provide accuracy, repeatability and fast response.
7. Local digital display with LCD, +/- 9999 counts, user scalable to flow rate or 0-100% with transmitter to provide input for controlling up or downstream flow control valve.
8. Construction - Body of 316 stainless steel construction with Hastelloy C thermowell sensors, 316 stainless steel compression fittings with stainless steel ferrule.

C. Design flow rate shall be 0 to 400 SFPS at an operating pressure of up to 12 PSIG.

D. Meter and components shall be suitable for a maximum for operation in an air temperature up to 350 $^{o}$F.

E. The flow transmitter shall include the following:
1. NEMA 4X, IP67 316 stainless steel enclosure for weather exposure.
2. 85 to 265 Vac (12-watt max.) input power.
3. HART (version 7) Bus Communications
4. RS-232C Communication Port
5. Two-line x 16-character LCD display for measured value and engineering units and second line user assigned temperature reading.
6. Integral mounting with sensor.
7. 4-20 mA input to the SCADA system for flow indication and totalization.

## 2.2 AIR FLOW CONDITIONER

A. An air flow conditioner shall be provided with each flow meter to neutralize flow profile irregularities caused by upstream valves, elbows, blowers or other flow disturbances that cause flow meter inaccuracies.

B. The flow conditioner shall be 316L stainless steel construction and sized for the full diameter of the carrier pipe as shown on the drawings.

C. Conditioner shall be flange mounted, ANSI.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install in accordance with manufacturers recommendations.

## 3.2 WARRANTY

A. Provide a manufacturer warranty of 2-years.

## 3.3 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

B. A minimum of one (1), eight (8) hour day excluding travel shall be included for the manufacturers field inspection, startup and training of operator personnel.

END OF SECTION

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SECTION 40 71 69
OPEN CHANNEL FLOW METERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Ultrasonic meter for monitoring flow in a parshall flume.
   2. Transmitters.
   3. Indicators.
   4. Integrators.

B. Related Requirements:

| | | |
|---|---|---|
| 1. | Section 01 33 01 | Submittal Requirements EPMS |
| 2. | Section 26 45 00 | Supervisory Control and Data Acquisition (SCADA) |
| 3. | Section 40 71 87 | Parshall Flumes |
| 4. | Division 26 | Electrical |

### 1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

### 1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with the parshall flume and SCADA integrator.

### 1.4 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.

C. Shop Drawings:
   1. Indicate system materials and component equipment.
   2. Submit installation requirements and other details.
   3. Operation and maintenance manuals

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

A. The open channel flow meter shall be of a design compatible with the existing Teledyne ISCO 4700 Refrigerated Sampler at the plant and for operation on a 24” Parshall Flume with influent wastewater.

B. The referenced manufacturer is named to establish standards of quality and to match the existing ultrasonic level meter within the caustic tank on site. Equal products of other manufacturers complying with these specifications may be provided as an alternative for the Owner’s consideration.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' experience and a minimum of twenty (20) similar tank applications.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store equipment according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 1-year manufacturer's warranty from the date of Owner acceptance of 18 months from delivery for ultrasonic-level measurement devices.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. The ultrasonic flow meter(s) shall be furnished complete with two (2) transducer sensors, one (1) multi-channel flow meter and accessories for monitoring and totalizing open channel flow from two (2) Parshall Flumes as shown on the Drawings. The meter shall provide an output signal to the plant's SCADA system for each individual Parshall Flume flow and the total combined flow. A 4-20 mA output signal shall also be provided to the influent automatic sampler and three (3) chemical metering pumps used for phosphorus removal. Supply of the flow meter and transducer sensors shall be coordinated to assure compatibility for a complete operating system to provide flow proportional sampling with the existing Teledyne ISCO 4700 Refrigerated Sampler and flow proportional adjustment of the chemical metering pumps used for phosphorus removal.

2.2 TRANSDUCER SENSOR

A. Each transducer sensor shall consist of a single ultrasonic transducer housed in a rugged, watertight, dust-tight, submersible, corrosion resistant (self-certified NEMA 4X, 6 and IP67) Xenoy plastic enclosure. The sensor shall include a temperature probe to automatically compensate for air temperature changes. The sensor shall automatically adjust its gain in response to echo strength to maximize performance in the presence of steam, foam, and turbulence. The sensor shall include variable blanking distance to ignore echoes from within a programmable distance from the sensor.

B. The level measurement span shall be from 0 to 10 feet. The level shall be measured with a maximum error of +/- 0.02 feet (+/- 0.006 m) over a head change of 1 foot or less and +/- 0.03 feet (+/- 0.009 m) over a head change of 1 to 10 feet (0.31 to 3.05 m). The temperature coefficient shall be +/- 0.000047 per degree F times the distance from the transducer to the liquid surface over the compensated temperature range of -22 to 140 degrees F.

C. The sensor cable length shall be coordinated with the site requirements to provide connection of the probes and flow meter without splices. The cable shall terminate in a sealed, military style connector so that the sensor can be easily replaced in the field.

D. Stainless-steel mounting brackets shall be supplied for mounting of each transducer sensor. It shall be possible to suspend the sensor using only the cable.

2.3 FLOW METER

A. Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch weirs, rectangular weirs with and without end contractions, Cipolletti weirs, and Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, and HL flumes. The flow meter shall accept a two-term, level-flow rate polynomial equation.

B. The flow meter shall have an RS-232 serial output to transmit information on all of its current readings. The data on the serial output shall be in ASCII format with values separated by commas. The serial output shall be at 1200, 2400, 4800, or 9600 baud. The flow meter shall output this data in response to the reception of a command on the serial port. The flow meter shall also be programmable to automatically transmit this data on a

periodic time interval. The data shall include the flow meter description, ID number, model number, date and time, battery voltage, level, flow rate, total flow, temperature, sampler activation status, sample number and bottle number.

C. The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

D. The flow meter shall be powered by 12 VDC power with external, uninterrupted nickel-cadmium backup battery.

E. The flow meter shall be housed in a rugged, lockable, watertight, dust-tight, corrosion resistant (self-certified NEMA 4X and IP66) enclosure. The enclosure shall include a carrying strap, a wall mounting bracket, and a clear polycarbonate window for viewing the LCD and printer without opening the enclosure. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

F. The flow meter shall be capable of activating a connected sampler based on a combination of level and/or flow rate.

G. The flow meter shall have a 12-volt pulse output or 4-20 mA for signaling a connected automatic sampler to collect flow proportioned samples, as well as power to two wire transmitters with flow meter at existing headworks structure. The flow meter shall have outputs to the sampler indicating when a sample is collected.

H. The flow meter shall contain a tactile keypad and a 2-line, 80-character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, total flow in user-selectable units of measure. The totalizer on the LCD shall be resettable. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting. A separate non-resettable, mechanical totalizer shall also be included in the meter.

I. The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 12 user-defined partitions. Each partition shall be programmable to store level and flow rate. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120-minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. Triggering events in slate mode shall be selectable from level or flow rate. The internal data storage memory in the flow meter shall be programmed using a software program on an IBM PC or compatible computer. The software shall also retrieve stored data from the flow meter and generate graphs and reports from stored data. The computer shall communicate with the flow meter using a direct RS-232 connection, or an internal telephone modem.

J. The flow meter shall include an internal isolated analog output. The output shall be programmable to output level or flow rate. The analog outputs shall be programmable to output 4 to 20 mA and the outputs shall be averaged on a programmable time interval of 0, 15, 30 or 60 seconds. The flow meter shall allow the analog outputs to be manually controlled to test the operation of connected equipment.

K. A minimum of 20 feet of connecting cable shall be provided for connection to the sampler with the appropriate end connector compatible with the automatic sampler.

L. Mounting:
   1. Remote mounting flow meter as shown on drawings.
   2. Mounting: Provide stainless-steel mounting accessories and hardware for mounting over the parshall flume within the channel.

M. Accessories:
   1. Current signal output simulation.
   2. Empty pipe detection.
   3. Self-diagnostics.
   4. Automatic zero adjustment.
   5. Stainless-steel sunshield.
   6. Signal Cable: Provided by flow meter manufacturer.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of meters.

C. Certificate of Compliance:
   1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
   2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

A. Coordinate location and orientation of flow meter with final equipment installations.

B. The ultrasonic flow meters shall be installed in accordance with the specifications, local codes, and the installation instructions and recommendations of the manufacturer. The contractor shall become familiar with the recommended handling and installation procedures used with ultrasonic flow meters to insure the meter and sensor are not damaged and that the flow meter is installed in a manner that is consistent with obtaining good open channel flow results.

C. Startup and Training: After installation, the manufacturer shall provide the services of a trained sampler technician for a period of one (1) day exclusive of travel to confirm proper installation, place the flow meter into service and train the Owner’s personnel in the proper operation and maintenance procedures

D. Ensure that instruments are located to be easily accessible for maintenance.

## 3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Testing: Test and calibrate flow meter to demonstrate that it meets specified accuracy requirements.

C. Equipment Acceptance:
   1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
   2. Make final adjustments to equipment under direction of manufacturer's representative.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

## 3.4 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 71 87
PARSHALL FLUMES

## PART 1 GENERAL

### 1.1 SUMMARY

A. The CONTRACTOR shall furnish and install one (1) Parshall Flume as shown on the drawings and specified herein.

### 1.2 Related Work

A. See the following sections specifications for related work:
   1. Section 01 43 13 - References
   2. Section 01 33 01 – Submittals EPMS
   3. Section 40 71 69 - Open Channel Flow Meters

### 1.3 SUBMITTALS

A. Shop drawings shall be submitted to the ENGINEER for approval and shall include:
   1. Outline drawings showing equipment shipping dimensions and weights, location of accessories and clearances required.
   2. Operation & maintenance manuals

## PART 2 PRODUCTS

### 2.1 DESIGN CRITERIA

A. The flume shall be a 24-inch Parshall flume for measuring flows from 190 gpm to 14,900 gpm and designed for installation within a 4-foot-wide concrete channel as shown on the drawings with inlet and outlet adapters to transition flow between the channel and the flume.

B. Flume dimensions tolerance shall be within plus of minus 3/32nd inch in the throat and plus or minus 1/8th inch elsewhere.

C. The flume liner shall be full length, molded fiberglass reinforced polyester laminated in one piece. The interior surface shall have a 10 to 15 mil white gelcoat backed by a resin rich layer and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than 30% glass by weight. Nominal thickness of walls and floor shall be a minimum of l/4 inch. Minimum principal properties shall be as follows:

| | |
|---|---|
| Coefficient of Linear Thermal Expansion: | 0.9 x 10-6 in/in/°F. |
| Tensile Strength | 14,000 psi |
| Flexural Strength: | 25,000 psi |
| Flexural Modulus: | 800,000 psi |
| Barcol hardness: | 30 |

All stainless steel shall be T-304

D. The flume shall be reinforced with box section stiffeners down the sides and across the bottom. The stiffeners shall be joined together at the knee to form a rigid dimensionally stable flume. The freestanding flume shall be strong enough to hold a 30" depth of water without visible distortion. Stiffeners across the top shall be permanent FRP angel/channel or temporary wood spreaders as required to provide sufficient strength and structural support to resist stresses that occur during shipping and proper installation of the flume.

E. Locking clips shall be fastened along the sides of the flume to be used for anchorage into a concrete channel.

F. The flume shall be furnished an adjustable T-304 stainless steel support bracket to mount an ultrasonic transducer over the waterway.

G. The Parshall flume shall be equipped with a head gage molded into the flume. The head gage shall be graduated in 100ths of a foot and centimeters with ¾-inch high black numerals at each tenth of a foot.

## PART 3 EXECUTION

### 3.1 INSTALLATION

A. General: The Parshall flume shall be installed in accordance with the specifications, local codes, and the installation instructions and recommendations of the manufacturer. The contractor shall become familiar with the recommended handling and installation procedures used with fiberglass Parshall flume to ensure that the flume is not damaged and that the flume is installed in a manner that is consistent with obtaining good open channel flow results.

B. Handling and Storage: During loading, unloading and storage care shall be exercised to ensure that the flume is not dropped or otherwise damaged through impacting with solid surfaces. The flume shall be stored on a smooth surface, free of sharp objects, and if laid horizontally, shall be placed in such a way as to avoid structural damage to the inlet and outlet channels.

END OF SECTION

SECTION 40 72 13
ULTRASONIC LEVEL METERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ultrasonic-level measurement devices.
   2. Transmitters.

B. Related Requirements:
   1. Section 01 33 01 Submittal Requirements EPMS
   2. Section 43 41 16.16 Vertical Fiberglass Storage Tank and Accessories
   3. Section 26 45 00 Supervisory Control and Data Acquisition (SCADA)
   4. Division 26 Electrical

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. NSF International:
   1. NSF 61 - Drinking Water System Components - Health Effects.
   2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with the supplier of the vertical fiberglass storage tank.

1.4 SUBMITTALS

A. 01 22 01 – Electronic Project Management System and 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including connection requirements.

C. Shop Drawings:
   1. Indicate system materials and component equipment.
   2. Submit installation requirements and other details.
   3. Operation and maintenance manuals.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.

B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.6 QUALITY ASSURANCE

A. The ultrasonic level meter shall be of the Siemens HydroRanger 200 or approved equal to fit the tank nozzle shown on the drawings and shall have materials of construction and wetted parts compatible with liquid polyaluminum chloride (PAC) stored within the tank.

B. The referenced manufacturer is named to establish standards of quality and to match the existing ultrasonic level meter within the caustic tank on site. Equal products of other manufacturers complying with these specifications may be provided as an alternative for the Owner's consideration.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' experience and a minimum of twenty (20) similar tank applications.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 1-year manufacturer's warranty from the date of Owner acceptance of 18 months from delivery for ultrasonic-level measurement devices.

## PART 2 - PRODUCTS

### 2.1 ULTRASONIC-LEVEL MEASUREMENT DEVICES

A. Description:
   1. Application: Installation on FRP tank used for storage of Polyaluminum Chloride (PAC) with a pH of 3.5 and specific gravity of 1.2 at ambient temperatures.
   2. Measuring Range: Up to 20 feet.
   3. Operating Temperature Range: - 4 to 122 degrees F.
   4. Operating Pressure: Ambient conditions.

B. Operation: Menu guided.

C. Transmitters:
   1. Selected by sensor manufacturer to match sensor.
   2. Visual Display: Four digit.
   3. Output Signal: 4- to 20-mA dc.
   4. Location: As indicated on Drawings.
   5. Control Power:
      a. Wiring: As specified in Division 26 - Electrical.
      b. 120-V ac, single phase, 60 Hz.
      c. Furnish local transformers as required.
   6. Enclosures: NEMA 4X stainless steel.
   7. Mounting:
      a. Remote from sensor (at ground level).
      b. Pipe mounted control panel.
   8. Furnish cable, field preamplifiers, and signal conditioners as required to maintain accuracy from sensor to terminal device.

### 2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

### 3.2 INSTALLATION

A. Coordinate location and orientation of level probe assemblies with final equipment installations.

B. Ensure that instruments are located to be easily accessible for maintenance.

## 3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 4 hours on Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

C. Equipment Acceptance:
   1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
   2. Make final adjustments to equipment under direction of manufacturer's representative.

D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

## 3.4 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 40 91 16
MAGNETIC FLOW METER

PART 1 GENERAL

1.1 SUMMARY

A. Section includes: Specifications for Magnetic Flow Meter

1.2 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS: Requirements for submittals
B. Section 01 70 00 - Execution and Closeout Procedures
C. Section 33 32 16 - Rotary Drum Thickener Pump Station
D. Section 46 71 33 - Rotary Drum Thickening Equipment

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.4 QUALITY ASSURANCE

A. The magnetic flowmeter shall be of the Endress+Hauser PROline Promag 10 Series or approved equal to fit the line size shown on the drawings.

B. The referenced manufacturer(s) is named to establish standards of quality. Equal products of other manufacturers complying with these specifications may be provided as an alternative for the Owner's consideration.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience.

1.6 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 MAGNETIC FLOWMETER

A. Manufacturers:
   1. Rosemont, Endress+Hauser, Toshiba, Siemens or Equal
   2. Substitutions: EJCDC® C-200 – 2013 Instructions to Bidders

B. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of

electromagnetic induction and shall produce DC signals directly proportional to the liquid flow rate.

C. The magnetic flow meter shall provide an output signal to the Rotary Drum Pump Station control panel for modulation of the adjustable speed drives to provide a constant reset flow to the rotary drum thickener with changing pumping head.

D. Design flow rate shall be 0 to 500 gpm.

E. Each meter shall be furnished with a stainless-steel metering tube and carbon steel flanges with a polyurethane liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe.

F. The flow tube shall be provided with flush mounted electrodes. Ultrasonic electrode cleaning shall not be acceptable.

G. Flow tubes shall have 316 stainless steel liner protectors on all flow tubes supplied with each flanged meter.

H. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

I. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.

J. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.

K. The transmitter's preamplifier input impedance shall be a minimum of $10^9$-$10^{11}$ ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

L. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.

M. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.

N. Accuracy shall be 0.50% of rate over the flow velocity range of 1 to 30ft/sec. Optional .25% of rate accuracy available. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 115 VAC, 60 Hz.

O. The transmitter shall be furnished with licensed option for continuous flow meter and system verification and shall be activated as required by the specification or instruments list. The meter verification function shall be internal to the transmitter continuously comparing the transmitters current signature values with those set to establish a baseline and will provide a alert should meter determine it is operating outside configurable limits.

P. Flow tubes shall be 150-lb carbon steel flange mounted unless otherwise noted. AWWA C207 Table 3 Class D for 30" and larger diameter meters. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube shown in the Drawings and/or as specified.

## 2.2 SCADA SYSTEM OUTPUT

A. The magnetic flow meter transmitter shall provide input to the SCADA System for flow indication and totalization.

# PART 3 EXECUTION

## 3.1 INSTALLATION

A. Install in accordance with manufacturers recommendations.

## 3.2 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

B. A minimum of one (1), eight (8) hour day excluding travel shall be included for the manufacturers field inspection, startup and training of operator personnel.

END OF SECTION

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SECTION 40 92 13.13.
ELECTRIC ACTUATORS

PART 1 GENERAL

1.1 SUMMARY

A. Contractor shall provide all labor, materials, tools, equipment and all else necessary for installation of electric motor actuators on gates and valves as shown in the Actuator Schedule and on Contract Drawings.

B. Scope:
1. Each actuator shall be capable of fully opening and closing the gates and valves on which it is installed under the maximum load and exposure to varying temperatures. The actuator shall be self-locking under normal operating conditions in order to hold the valve in an intermediate position. The actuator shall be designed for outdoor service and capable of mounting in any position. The actuators shall include in one integral unit the motor, power gearing, travel limit switches, torque limit switches, handwheel, terminals for motor power and controls and separable thrust base and drive nut. Actuators shall be supplied by the Sequencing Batch Reactor and Ultraviolet (UV) equipment manufacturers and integrated into the respective control panel(s) for supply of power and automated control with installation, wiring and conduit between the actuators and equipment control panel(s) by the Contractor

1.2 RELATED WORK:

A. See the following specifications for related work specified elsewhere:
1. EJCDC® C-200 - Instruction to Bidders.
2. Section 01 33 01 - Submittal Procedures EPMS
3. Section 01 70 00 - Execution and Closeout Procedures
4. Section 35 20 16 - Sluice, Channel and Weir Gates
5. Section 26 45 00 - Supervisory Control and Data Acquisition (SCADA)
6. Section 43 32 63 - Ultraviolet Disinfection System
7. Section 44 46 10 - Sequencing Batch Reactor & Aerobic Digestion Equipment
8. Division 26- Electrical

1.3 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are EIM, Limitorque Inc or Rotork Control, Inc. To be considered and equal manufacturer, the manufacturer must be able to provide a minimum of twenty (20) site references with at least five (5) years' experience of trouble free operation for all technologies and devices used with the actuator. This must include torque and position sensing, lubrication and electrical compartment design.

PART 2 PRODUCTS

2.1 GENERAL

A. Contractor shall verify the gate and valve stem size and other essential dimensional characteristics before final purchase.

B. The automated operation and power supply to the actuators shall be integrated into the control system for the SBR equipment and UV system with power and control wiring installed by the Contractor. Automated operation of gates shall enable the opening and closing of the gates remotely.

2.2 ENCLOSURE

A. The entire actuator enclosure shall be watertight according to NEMA 4 Standard. All covers and entries shall be sealed by means of O-rings. All conduit entries shall be properly sealed to maintain the watertight housing. Terminal compartment and limit switch compartment covers shall be fastened to the gear housing by stainless steel bolts which are "captured" to prevent loss when covers are removed.

2.3 HOUSING

A. The gear housing and all load bearing enclosures shall be cast iron. The non-load bearing enclosures and covers may be aluminum, cast iron or steel. All housings are to be adequately designed, manufactured and inspected to assure against the ingress of moisture.

2.4 GEARING

A. All power gearings shall be made of hardened steel or bronze and operate in an oil lubricant. Gearing shall be designed to withstand the stall torque of the motor without failure. The final drive shall be of the self-locking worm and wheel type to prevent creeping of the valve.

B. The drive nut shall be separable from the gear assembly to facilitate rapid mounting of the operator on the valve.

C. Gearing vent shall include a desiccant canister to assist with moisture entry into the gearing.

2.5 MOTOR

A. The motor and electrical components shall be designed for operation on a 460 volt/3 phase/ 60 Hz power supply.

B. The drive motor shall be specifically designed for actuator service characterized by high starting torque, low stall torque and low inertia.

C. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating.

D. The motor shall be Class H insulated with a time rating at least 15 minutes at 104° F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque.

E. The motor shall be induction type with Class F - tropicalized insulation. Three terminal switches are to be imbedded in the windings - one hundred twenty (120) degrees apart to insure safe motor shut-down during periods of high current draw resulting in a high temperature condition.

F. The motor shall be capable of operating in any position. It shall be properly sealed from the lubricant filled gearcase to allow the motor to be mounted in any position relative to the gearcase. Removal of the motor shall not result in loss of lubricant.

G. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement.

## 2.6 HANDWHEEL

A. A handwheel shall be permanently attached for manual operation. A positive pushbutton style declutch mechanism shall engage the handwheel when required. The handwheel shall not rotate during motor operation. A fused or inoperable motor shall not prevent manual operation. Motor operation shall always take precedence over manual operation.

## 2.7 LIMIT SWITCHES

A. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions.

B. Limit switches and the limit switch drive shall be an integral part of the actuator.

C. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual modes of operation.

D. A minimum of four (4) contacts two (2) normal open and two (2) normally closed shall be supplied at each end of valve travel. The contacts shall be of silver and adequately rated to carry the control current. All contacts are to be completely sealed in a NEMA 4 enclosure to prohibit electrical shock while adjusting; eliminate shorting out; and ensure that contaminants do not foul the contacts.

E. Limit switches shall be fully adjustable when power is applied to the actuator.

F. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle.

## 2.8 TORQUE SWITCHES

A. Torque limit switches shall be provided to de-energize the motor control circuit when the valve encounters an obstruction during travel. Each actuator shall have an open direction torque switch and a close direction torque switch.

B. The torque switches shall be mechanically operated and settable in units of torque. Torque switches shall be calibrated prior to the actuator's assembly to the valve.

C. Torque switches shall be adequately rated to carry the control current. The contacts are to be completely sealed.

D. The actuators shall be designed for high torque conditions associated with potential freezing conditions and ice formation on gates.

2.9 HEATER

A. An adequately sized space heater or electric heat tracing shall be installed in the limit switch compartment to aid in the prevention of damage resulting from condensation and freezing conditions.

2.10 MECHANICAL DIAL POSITION INDICATOR

A. The dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall operate when the actuator is in either the electric mode or manual mode.

B. Four (4) contacts shall be selectable to signal the following:
1. Valve opening and closing
2. Valve moving (continuously or pulsing)
3. Motor tripped on torque in mid-travel
4. Motor stalled
5. Actuator being operated by handwheel
6. Any positioner or position transmitters shall be contactless.

2.11 ELECTRICAL TERMINAL HOUSING

A. The electrical terminals shall be housed in a compartment isolated from the limit switch/torque switch compartment. All control and motor power terminations shall be to plug and socket assembly in order that removal of the terminal compartment cover simultaneously disconnects all wiring with the actuator. A quantity of two - ¾ inch NPT conduit entries shall be furnished. Electrical terminal housing shall be isolated by means of a double seals from the actuator housing.

2.12 CONTROLS (OPEN/CLOSE SERVICE)

A. Motor controls shall be furnished as an integral part of the actuator. A wiring schematic shall be furnished with each actuator.

B. Motor controls shall consist of mechanical reversing contactors to reverse motor direction (transformer for control power, phase discriminator trip or thermal switch trip.) Local control shall be by an "open-stop-close" control switch. Selection of operation from local or remote source shall be by padlockable "local-off-remote" selector switch. Remote signals shall be accepted by the actuator through optical isolators or interposing relays.

PART 3 EXECUTION

3.1 ACTUATORS

A. Actuators shall be installed in accordance with the manufacture's recommendations.

3.2 START-UP SERVICES

A. Actuators shall be started up only by authorized actuator manufacture representative. All synchronous motors shall be tested with jobsite power to measure and document proper operational parameters for warranty qualification. Proof of test and affidavit of testing shall be required for final release of payment.

B. Performance tests of the actuator equipment shall simulate each typical valve or gate load and the following parameters should be recorded:
   1. Current at maximum torque setting
   2. Torque at maximum torque setting
   3. Flash test voltage
   4. Actuator output speed or operating time
   5. The test certification should record details of specification, to include gear ratios for both manual and automatic drive, closing direction and wiring diagram code number.

C. After installation, a start-up technician shall inspect the complete installation, place the equipment into permanent operation, instruct the OWNERS's personnel in operation and maintenance and perform field tests to insure proper installation. A minimum of one (1), 8-hour day at the job site excluding travel shall be included for this service.

D. After installation and final testing, the manufacturer shall certify to the OWNER/ENGINEER that all equipment is properly installed, and that the plant operators have been instructed on proper operation and maintenance procedures. Local manufacturer's representatives are not acceptable to perform these tasks.

## 3.3 ACTUATOR SCHEDULE

| Gate Identification | Actuator Location | Actuator Mounting | Power Supply | Controls Voltage | Enclosure Rating | Comments |
|---|---|---|---|---|---|---|
| Channel Gate MSG-107 | SBR Flow Splitter | Y | 480 V/ 3 P | 120 VAC | EX | |
| Channel Gate MSG-108 | SBR Flow Splitter | Y | 480 V/ 3 P | 120 VAC | EX | |
| Channel Gate MSG-109 | SBR Flow Splitter | Y | 480 V/ 3 P | 120 VAC | EX | |
| Channel Gate MSG-110 | SBR Flow Splitter | Y | 480 V/ 3 P | 120 VAC | EX | |
| Butter Fly Valve V-239 | SBR #3 Decanter Valve | P | 480 V/ 3 P | 120 VAC | EX | |
| Butterfly Valve V-240 | SBR #4 Decanter Valve | P | 480 V/ 3 P | 120 VAC | EX | |
| Channel Gate MGS-401 | UV #3 Influent | Y | 480 V/ 3 P | 120 VAC | WT | |
| Channel Gate MGS-402 | UV #4 Influent | Y | 480 V/ 3 P | 120 VAC | WT | |
| MBV-1 | SBR #1 Air Control Valve | BFV | 115 V/ 1 P | 120 VAC | WT | Modify Existing EIM Actuator to upgrade electronics by adding ACM card for modulation. |

| | | | | | | |
|---|---|---|---|---|---|---|
| MBV-2 | SBR # 2 Air Control Valve | BFV | 115 V/ 1 P | 120 VAC | WT | Modify Existing EIM Actuator to upgrade electronics by adding ACM card for modulation |
| MBV-3 | Digester #1 Air Control Valve | BFV | 115 V/1 P | 120 VAC | WT | To fit existing BFV 2" nut. |
| MBV-4 | Digester #2 Air Control Valve | BFV | 115 V/1 P | 120 VAC | WT | To fit existing BFV 2" nut. |
| MBV-5 | Sludge Holding #1 Tank Air Control Valve | BFV | 115 V/1 P | 120 VAC | WT | To fit existing BFV 2" nut. |
| MBV-201 | SBR # 3 Air Control Valve | BFV | 480 V/ 3 P | 120 VAC | WT | |
| MBV-202 | SBR # 4 Air Control Valve | BFV | 480 V/ 3 P | 120 VAC | WT | |
| BV-209 | Digester #3 Air Control Valve | BFV | 480 V/ 3 P | 120 VAC | EX | |
| BV-210 | Digester #4 Air control Valve | BFV | 480 V/ 3 P | 120 VAC | EX | |
| BV-212 | Sludge Holding Tank #2 Air control Valve | BFV | 480 V/ 3 P | 120 VAC | EX | |

**ABBREVIATIONS:**

P: Pedestal Mounted
PB: Pedestal Mounted with Wall Bracket
Y: Yoke Mounted
BFV: Butterfly Valve Mounted

**ENCLOSURE RATINGS:**

WT: Watertight IP68/NEMA 4&6
EX: Explosion Proof

END OF SECTION

SECTION 40 97 00
PUMP CONTROL PANELS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This section gives the requirements for installation of a pump control panel and components for control & monitoring operating status of the Post Equalization Pumps.

### 1.2 RELATED DOCUMENTS

A. See the following specifications for related work:

| | | |
|---|---|---|
| 1. | Section 01 33 01 - | Submittal Procedures EPMS |
| 2. | Section 01 70 00 - | Execution and Closeout Procedures |
| 3. | Section 43 21 39 - | Submersible Pumps |
| 4. | Section 44 46 10 - | Sequencing Batch Reactor & Aerobic Digestion Equipment |
| 5. | Division 26 | Electrical |

### 1.3 CERTIFICATIONS

A. The instrumentation panel and individual components shall be 3rd part listed; UL, ETL, CSA, etc.

B. The control panel shall be listed to UL 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

### 1.4 DESCRIPTION OF OPERATION

A. The control panel shall control the operation of pumps, unless indicated otherwise.
   1. The control panel for the Post EQ PS shall initially control the operation of five (5) pumps.

B. Manual mode, selector switches in "HAND" position:
   1. Selected motor operates.
   2. Post EQ PS: Speed of the operating pump can be changed with a panel mounted speed potentiometer or digital speed selector.
   3. "Pump Down" pushbutton will allow operation of motors below the low-level shutoff level.

C. Automatic mode, selector switches in "AUTO" position:
   1. A pressure transducer system with 4-20 mA output shall be used for level sensing with float switches providing redundant sensing for high-level alarm and low-level shutoff.
   2. See specification Section 44 46 10, Submersible Pumps, for sequence of operation for control requirements.
   3. The lead pump shall alternate for each pumping cycle.
   4. A time delay shall be introduced for the lag pump to prevent simultaneous starting after power failure or similar incidents.

D. Relays and circuitry for monitoring and indication of the following shall be provided:

1. Motor RUN status.
2. Pump seal failure. A seal failure condition shall not stop motors from operating.
3. Motor overtemperature. A motor over-temperature condition shall prevent the motor from operating until the condition is cleared.
4. Motor overload. A motor overload condition shall prevent the motor from operating until the condition is cleared by manual reset.
5. VFD fault (Post EQ PS only).
6. Loss of power.
7. High level – Post EQ Tank.
8. Low level. A low-level condition shall prevent motors from operating, unless manually bypassed by the momentary position "Pump Down" pushbutton.

E. Alarm horn and light:

1. Activated by:
   a. High Post EQ tank level.
   b. Pump seal fail.
   c. Motor overtemperature.
   d. Motor overload.
   e. VFD fault (Post EQ PS only).
   f. Loss of power.

2. The alarm horn shall be silenced by an alarm silence pushbutton.
3. A reset pushbutton shall be provided to clear the high-level alarm condition.

F. Auxiliary signal, dry contacts shall be provided with circuitry wired to terminal blocks for connection to an external SCADA unit for the following:

1. High Post EQ tank level.
2. Pump seal fail.
3. Motor overtemperature.
4. Motor overload.
5. VFD fault (Post EQ PS only).
6. Loss of utility power.

G. See pump control panel detail on drawings for additional information.

1.5 SUBMITTALS

A. Shop drawings adequate for control panel fabrication, installation and maintenance shall be submitted and approved prior to manufacture. The adequacy of shop drawings shall be determined solely by the Owner's Representative. Drawings shall include:

1. Elementary control (ladder) diagram.
2. Interconnection wiring (schematic) diagram.
3. Interior and exterior panel component layout drawings.
4. Dimensioned outline drawing of the enclosure with mounting supports.
5. Component catalog cuts and Contractor's installation drawings.

B. Post fabrication submittals shall include:

1. Device nameplate list.
2. Written certification of the UL serialized label for the pump control panel.
3. Operation and Maintenance Manual per Section 01 33 01 Submittals.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

A. General:

1. Control panel shall consist of main input terminals, phase monitor, surge protector, control power transformer, selector switches, pushbutton operators, auxiliary relays, timers, alternator, indicator lights, elapsed time meters, circuit breakers, variable frequency drives, strip heater with thermostat, duplex GFCI receptacle, alarm strobe and horn, circuitry, and terminal blocks with all components mounted in one common enclosure. The controls assembly shall provide means to operate each motor manually or automatically. Power supply shall be as indicated on the drawings.

2. Control power shall be 120 volts.

B. Enclosure:

1. The electrical control equipment shall be mounted within a NEMA type 4X, stainless steel, gasketed, dead front enclosure of welded and seamless construction.
2. External hardware, hinges, etc., shall be 300 series stainless steel.
3. Weather door: Gasketed, continuously hinged with doorstop, three-point latch, quick release latches and a hasp assembly for padlocking.
4. Deadfront / interior swing panel for mounting selector switches, pushbutton operators, and LED indicators: Continuously hinged deadfront held closed with two slotted nickel plated brass captive panel screws with knurled edges to allow for finger or screwdriver tightening.
5. Control compartment shall incorporate a fixed, rigid back panel on which control components shall be mounted. Back panel shall be secured to enclosure with collar studs. The back panel shall be 12-gauge galvanized steel, painted with heavy-duty epoxy enamel after fabrication. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
6. Mounting provisions: Mounting lugs shall be provided for rack mounted panels.
7. Mounting feet shall be provided for self-supported panels.

C. Components:

1. A phase monitor shall be connected to the main power input terminals to prevent motor operation upon phase loss, phase reversal, under-voltage, and phase imbalance conditions. Upon restoration of satisfactory input voltage, the unit shall automatically reset after a user programmable time delay. Phase monitor leads shall be fused in accordance with the manufacturer's requirements.
2. A surge protection device for the control panel shall be connected to the main power input terminals.
3. A 120V control power transformer shall be provided, sized in accordance with the loads to be supplied, plus 20% additional capacity. Panels installed at locations with rain hoods/sun shields shall supply an external fluorescent light fixture mounted under the hood.
4. Float switch circuitry shall be connected to intrinsically safe relays7 barriers.
5. Selector switches shall be heavy-duty, oil tight, manual return with standard knob. Switches shall be

clearly labeled according to function

6. Motor operator selector switches shall be three position Hand-Off-Automatic type, shall permit over-ride of automatic control, and allow manual operation or shutdown of each motor.
7. Pushbutton operators shall be heavy-duty, oil tight, watertight, NEMA 4, momentary position, fully guarded type.
8. Auxiliary and control relays shall be enclosed, general purpose relays with plug-in bases and transparent polycarbonate dust cover.
    a. Continuous rated coils with AC pickup voltages of 85% of nominal. Coil voltage as required.
    b. Contacts rated at 120 VAC, 80 percent P.F., 10 amperes continuous, 30 amps make, 3 amps break.
    c. Relays shall feature an LED indicator that is lit when the coil is energized.
9. Timer delay relays shall be enclosed, general purpose, adjustable time delay relays with plug-in bases.
    a. Operating voltage as required.
    b. Contacts rated at 120 VAC, 80 percent P.F., 10 amperes continuous, 30 amps make, 3 amps break.
    c. Timing range and ON or OFF operate delay type relays as required for the application.
    d. Transparent polycarbonate dust cover with adjustable timing dial.
10. Typical alternator relays shall be enclosed, general purpose duplex alternating relays with plug-in bases and transparent polycarbonate dust cover.
    a. Continuous rated coils with AC pickup voltages of 85% of nominal. Coil voltage as required.
    b. Contacts rated at 120 VAC, 80 percent P.F., 10 amperes continuous, 30 amps make, 3 amps break.
    c. Solid-state alternating circuit driving electro-mechanical relay coil.
    d. Relays shall feature state indicating LEDs in the cover.
    e. Provided for alternation of the lead pump for each run cycle.
    f. Alternator control for the Post EQ PS shall be provided by a pump sequencer capable of controlling five pumps. See specification Section 11311, Submersible Non-Clogging Pumps, paragraph 2.15.1, Sequence of Operation for control requirements.
11. Panel indicators shall be heavy-duty, oil tight, push-to-test with 120V LEDs.
12. Running time meters for each motor shall be provided.
    a. Non-resettable, hour indicating, with 6-digit registers.
    b. *YA"* high numbers, white on black background. Last digit for tenths of an hour shall be of contrasting color.
13. Individual magnetic, instantaneous trip circuit breakers shall be provided for each motor. Breakers shall be lockable in the OFF position. Breakers shall be sized in accordance with the nameplate rating of the motor provided.
14. Individual variable frequency drives shall be provided for each motor.
    a. Description: NEMA ICS 2, pulse-width-modulated, variable-frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
    b. Size VFDs in accordance with the nameplate rating of the motor provided.
    c. Unit operating requirements:

1. Input ac voltage tolerance of 480 V, plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Capable of driving full load, under the following conditions, without derating:
    a. Ambient Temperature: 14 to 122 deg F.
    b. Humidity: Less than 90 percent (non-condensing).
    c. Altitude: 3300 feet (1000 m).
4. Overload Capability: 1.5 times the base load current for 60 seconds.
5. 4-20mA reference input signal

d. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction.

e. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

f. Control Signal Interface: Provide the following:
    1. Input Signal Interface: Two analog inputs 4-20 mA, and 9 programmable digital inputs.
    2. Output Signal Interface: Two analog output signals (4-20 mA)., One signal shall be used for an output frequency display at the pump control panel. The other signal will be used for an output to the plant SCADA system. The outputs shall have the capability of being programmed to any of the following:
        a. Output frequency (Hz).
        b. Output current (load).
        c. Motor speed (rpm).
        d. Set-point frequency (Hz).
    3. Remote Indication Interface: Dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
        a. Motor running.
        b. Motor overload.
        c. VFD fault

g. VFDs shall feature auxiliary contacts for external monitoring of run indication, overload shutdown, and VFD fault.

h. Standard Display:
    1. Output frequency (Hz).
    2. Set-point frequency (Hz).
    3. Motor current (amperes).
    4. DC-link voltage (VDC).
    5. Motor torque (percent).
    6. Motor speed (rpm).
    7. Motor output voltage (V).

i. Line Reactor: If mounted externally to the control panel enclosure, provide NEMA 4X stainless steel enclosure. j. Fault log maintaining a history of the last four faults with time and date stamp for each. k. Manufacturers: Allen-Bradley, Danfoss, G.E., Siemens, Square D, Yaskawa. Design Basis: Allen-Bradley.

16. Front panel mounted speed potentiometers or digital speed selectors shall be provided for each VFD.
17. A strip heater with thermostat shall be provided to prevent the formation of condensation within the control panel interior.
18. A fluorescent light, switched when the panel door is opened shall be provided for the control panel interior.
19. A ground fault circuit interrupter receptacle shall be provided as a convenience outlet.

20. Alarm strobe / beacon:
    a. Red LED; 120,000 hour light source life.
    b. NEMA 4X; mount to control panel enclosure exterior in a waterproof matter with closed cell neoprene gasket.
    c. The strobe shall flash at approximately 65 flashes per minute.
    d. Design basis: Edwards 109R-N5, or equivalent by Federal Signal or Maxi-Signal.

21. Alarm horn shall be provided on the control panel exterior, with waterproof connections to the control panel. Design basis: Edwards 876-N5, or equivalent by Federal Signal or Maxi-Signal.

22. Terminal blocks shall be provided for connection of both internal connections and connections for external circuitry.
    a. Channel mounted, sectional type.
    b. Rated 600 volts, 20 amps minimum.

23. Labeling:
    a. All switches, pilot lights, control devices, major components, etc., shall be clearly labeled according to function with engraved plastic plates, black with white core. Minimum letter size shall be 1/8 inch.
    b. All conductors and terminal strips shall be labeled, matching schematic and wiring diagrams.
    c. Identification labeling shall match the bill of materials, schematic diagram, and wiring diagram.
    d. Schematic and wiring diagrams shall be displayed via a placard mounted to the inside surface of the panel door.

24. All other components necessary for a completely operable system performing the functions required shall be supplied.

D. Operating Controls and Instruments: All operating controls and instruments shall be securely mounted in such a manner that any or all standard options specified may be added without rearrangement of existing controls and instruments. All controls and instruments shall be clearly labeled to indicate function.

E. Wiring:

1. All wiring workmanship and schematic wiring diagrams shall be in compliance with applicable standards and specifications for industrial controls set forth by the Joint Industrial Council (JIC), National Machine Tool Builders Association (NMTBA), National Electrical Code (NEC), Division 16 of these specifications and other pertinent electrical codes and standards.
2. All control circuit wiring shall be, stranded copper, color coded and clearly marked at each end to match schematic wiring diagrams, and of adequate size to safely carry required electrical loads. All control wires shall be marked using T&B Shur-code sleeve markers. All wires on the back panel shall be contained in wire troughs with removable covers to facilitate field repairs and addition of optional/additional components. Splices shall not be used.

OPERATIONS AND MAINTENANCE MANUALS

A. Prepare an operation and maintenance manual for the control equipment. Manuals shall be made up with hard cover post type binders. Include index, tabbed section dividers, all approved shop

drawings, installation, and maintenance instructions packed with equipment, and parts lists.

B. Provide a written description of equipment operation, special features and maintenance requirements.

C. Provide instructions for setting all adjustable components. Record the final field settings of all adjustable components in a comprehensive table.

D. Large sheets shall be neatly folded and installed with post hole reinforcements such that sheets will unfold without need to open binder posts.

2.4 SPARE PARTS

A. One complete set of fuses.

B. One operating coil for each size of AC contactor provided.

C. One set of overload relays for each type and rating provided.

D. One pilot light with lens for each type provided.

PART 3 - EXECUTION

3.1 SHIPMENT AND STORAGE

A. Wrap pump panel enclosure surfaces in a protective plastic wrap before crating and shipment. Crate the pump control panel to protect it from damage during shipment and storage.

B. Store all electrical materials and equipment at the site in trailers or temporary buildings that provide protection from the effects of weather.

3.2 COORDINATION

A. Make changes to the electrical design at no additional cost if the motors supplied have electrical ratings and characteristics different from the motor specified or shown. Provide calculations used to make revised component selections. Revised selections shall comply with the specifications. Verify that final field adjustments comply with factory recommendations.

3.3 INSTALLATION

A. General: The Contractor shall receive, handle and store all equipment and materials to be installed, being careful to prevent any damage during transport and storage. All equipment stored shall be protected from weather in a manner recommended by the manufacturer.

1. All equipment shall be handled and installed in accordance with written instructions and approved shop drawing details of the manufacturer and as required by the drawings.

2. If the Contractor determines that existing conditions do not permit proper installation, he shall immediately notify the Owner's Representative.

B. Instrumentation panel and accessory equipment shall be installed in strict accordance with the manufacturer's instructions and good practice in a workmanship manner.

## 3.4 START-UP TESTING

A. Test instrumentation system for proper function and sequencing of all motors, indication, and remote notification capabilities.

B. Conduct a test for observation by the Owner's representative to demonstrate operation in accordance with the drawings and specifications.

END OF SECTION

SECTION 41 22 13.13
BRIDGE CRANES

PART 1 GENERAL

1.1 SUMMARY

A. Scope
   1. Related Work Specified Elsewhere:
      a. Structural Steel (Section 05120)
      b. Electrical (Division 16)
   2. Work Included in this Section: Furnish and install bridge crane, crane rails and standard controls as specified herein with all incidental components required for the system to be ready for use. Electrical trade shall have final power connection only.

1.2 STANDARDS

A. Comply with WHH applicable requirements of ANSI B-30.17 and OSHA Par.1910.179 for top running single girder cranes.

1.3 SUBMITTALS

A. Submit manufacturer's comprehensive product data for all equipment. Provide installation, operation and maintenance instructions along with manufacturer's parts breakdown, product warranty, and address and telephone number of the nearest service representative.

1.4 MANUFACTURER

A. Acceptable manufactures are:
   1. Acco Babcock, Inc
   2. DeShazo Crane Co.
   3. Duff-Morton, Co.
   4. Robbins and Myers, Inc.
   5. Yale Industries Products
   6. Or Equal.

PART 2 PRODUCTS

2.1 CODES AND STANDARDS

A. A. The crane system will meet or exceed ANSI B30.11 specifications, as they pertain to bridge cranes.

B. B. The terms used in this specification will be in accordance with the definitions prepared by the MMA (Monorail Manufacturers Association) MH27.1 and ASME/ANSI B30.11.

C. OSHA specification 1910, as it applies to bridge cranes, will be adhered to.

## 2.2 MATERIALS

A. Bridge Crane: Span and capacities are shown on the Drawings. Travel speed shall be 65 feet per minute. Lift speed shall be 20 feet per minute.

B. Beam: Bridge beam shall be designed in accordance with latest specifications of the Crane Manufacturers Association of America and shall be of standard structural shapes, constructed in accordance with AISC specifications. Under full load the beam deflection shall not exceed 1/600 of the span. Bridge beam shall be selected structural steel members and shall provide level and straight tread surfaces for the hoist trolleys. The bridge beam shall be braced and welded to maintain squareness with trucks. Bridge beam shall have adequate lateral stiffness with minimum lateral stiffness with minimum lateral moment of inertia of 1/20 that of the vertical moment of inertia. Provide tapered top ends of bridge beam as indicated.

C. End Trucks: The end truck frame shall be welded from structural shapes into a single unit as to prevent distortion and mismatch of gears under maximum rated loads. End truck wheel base shall be a minimum of 1/8 of crane span. One wheel in each truck shall be geared and meshed with a pinion. The truck shall contain diaphragm members welded to truck frames to maintain alignment and distribute truck loads uniformly on inner and outer truck members. A wheel gear protecting guard shall be part of the end truck. The truck shall be designed so that the drop of the truck will be limited to one inch in case of axle or wheel failure. Attachment of end truck to bridge beam shall be by welding to insure alignment.

D. Crane Wheels: Crane wheels shall be double-flange alloy steel and have tread surfaces hardened to 375 to 425 Brinell. Each wheel shall be supported on tapered roller bearings mounted on stationary axles suitable to take radial and thrust loads. The wheels shall be lubricated at the factory with sodium-based grease and provided with a suitable reservoir of lubricant to eliminate the need for field lubrication. Wheel axles must have mounting nuts for bearing adjustment. Wheel mounting shall be designed so that axles and wheels can be removed without disturbing other truck elements of their alignment. Wheel treads shall be smooth, true and uniform within .010 inch tread diameter on all wheels.

E. Runways: Crane runways, runway rails, and stops shall be furnished to the General Contractor as instructed and coordinated with the information provided by the crane manufacturer. Runway rails shall be straight, parallel, level, and at the same elevation. The distance center to center and the elevation shall be within a tolerance of plus or minus 1/8". The runway rails should be standard rail sections of a proper size for the crane to be installed and must be provided with proper rail splices. See Section 05120.

F. Crane Drive: Each end truck shall be provided with a helical gear motor reducer. The drive motor for each truck shall be fully enclosed, 30-minute duty rated Class B insulation in a NEMA frame and shall comply with NEMA Performance Specification. A spring set, electrically released AC disk type brake shall be integrally mounted on each reducer in line with the motor. The motors

shall be integral with fully enclosed oil splash lubricated gear reducers, 2-speed motor. The gear reduction shaft shall be supported by precision ball or roller bearings.

G. Bearing Life: All bearings in the crane wheels and the gear reduction shafts shall be designed for 5,000 hours B-10 bearing life minimum.

H. Bridge Bumpers: The bridge shall be provided with bumpers capable of stopping the crane, not including the live load, at a rate of deceleration not to exceed three feet per second when traveling in either direction at 20% rate of speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40% of the rated load speed.

I. Rail Sweeps: Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the crane wheels.

J. Electrical Controls: Electrical controls shall be two speed operating on a voltage of 110 V, 60 H, 1-ph. Bridge control shall include a main line Contractor, manually operated fused main line disconnect with lock-out provision, branch circuit fuses, reversing bridge control and transformer with a fused secondary. Bridge beam should have electronic soft start circuitry. Bridge control shall be mounted on bridge in NEMA Type 3R enclosure activated from a pendant push button station from the trolley hoist. Crane drive motor (2 ½ hp) and hoist motor to operate on a supply voltage of 208 V, 3 Phase, 60 Hertz.

K. Bridge Conductors Wiring: Flat wire festoon tagline bridge conductor shall be provided with the crane to provide fully insulated bridge electrification. All other wiring of the crane shall be in rigid or flexible conduit in accordance with National Electrical Code.

L. Rope Hoist: Standard headroom electric wire rope hoist with geared trolley and single speed hoist motor. Rope hoist to have true vertical lift. Controls to be 3 pole magnetic reversing type in a NEMA Types 3R enclosure with momentary contact type buttons. Load break should hold fully capacity load independent of motor brake and can hold the load stationary in any position, 1 hp, 208 v, 3 phase, 60 Hz.

M. Painting: All structural parts shall be cleaned of rust and mill scale. The complete crane shall be given the appropriate number of coats of anti-corrosion primer and finish paint to protect surface from environmental damage. Type of paint and color of final coat shall be according to manufacturer's standard.

## PART 3 EXECUTION

### 3.1 INSTALLATION:

A. Comply with manufacture's detailed instructions, and coordinate crane rail erection with crane manufacturer’s instructions. Install complete system in working order. Provide necessary adjustments required for safe and efficient operation.

B. The contractor shall provide the services of a qualified manufacturer’s technical representative who shall adequately inspect the installation and test the equipment furnished under this Contract and

instruct the Owner's operating personnel in the operation and maintenance of the equipment. The services of a manufacturer's representative shall be provided for a period of not less than one day.

C. Upon completion of installation, the crane shall be load tested and certified for the rated capacity. Written certification shall be provided to the Owner.

D. The rated capacity shall be noted on the crane.

## 3.2 SPARE PARTS

A. The contractor shall furnish all special tools necessary to disassemble, service, repair and adjust the equipment and shall furnish a one-year supply of all recommended lubricating oils and greases.

B. The contractor shall furnish spare parts as recommended by the equipment manufacturer. All spare parts shall be properly packed and labeled. The parts shall be stored as directed by the Owner.

## 3.3 FIELD PAINTING

A. The equipment may be shop painted for end use as supplied by the manufacture. No less than 10 mils of an epoxy enamel paint will be acceptable. The paint shall be suitable to exterior use in a corrosive environment. The paint application shall be submitted to the Engineer for approval.

## 3.4 WARRANTY

A. The manufacturer will provide a suitable five-year warranty of all furnished equipment. The warranty period shall begin at substantial completion.

## 3.5 OPERATION & MAINTENANCE MANUAL

A. The contractor shall provide the designated number of Operation and Maintenance Manuals for the equipment. The manuals shall be printed for the equipment and shall be bound in one book. Copies of manuals by copiers shall not be allowed.

END OF SECTION

SECTION 43 12 19
POSTIVE DISPLACEMENT BLOWER ASSEMBLIES
(B-201, B-202, B-203, B-204, B-205, B-206, B-207, B-208)

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete installation of eight (8) new positive displacement blower assemblies and modifications to increase the speed and capacity of eight (8) existing blowers as shown on the plans and specified herein.

B. Blowers shall be supplied with the equipment provided by the Sequencing Batch Reactor and Aerobic Digester equipment supplier to ensure process compatibility.

C. Related Sections:
1. Section 01 22 01 - Electronic Project Management System
2. Section 01 33 01 - Submittal Procedures EPMS
3. Section 01 70 00 - Execution and Closeout Procedures
4. Division 26 – Electrical
5. Section 44 46 10 - Sequencing Batch Reactor & Aerobic Digestion Equipment

### 1.2 QUALITY ASSURANCE

A. The equipment specified herein is intended to be standard equipment for positive displacement air systems and be supplied by a single OEM to assure uniform quality and compatibility.

B. 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.

C. Blower packager must be an authorized distributor of the blower being supplied and must be factory authorized to perform warranty service.

### 1.3 SYSTEM DESCRIPTION

A. Each new blower assembly shall include a rotary lobe type positive displacement blower, electric motor, matched belts and sheaves, personnel protection guard, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, pressure gauge, wafer butterfly discharge isolation valve and rubber expansion joint.

B. Existing blowers serving the existing SBR No. 1 & 2, Digester #1 & 2 and Sludge Holding Tank #1 are to be modified by replacement of the existing pulley sheaves and belts to increase speed and capacity.

1.4 DESIGN REQUIREMENTS

A. The new blower assemblies located in Building No. 3A and serving the SBR No. 3 & 4, Digesters 3 & 4 and Sludge Holding Tank No. 2 shall meet the following minimum requirements:

| Blower No. | Primary Air Purpose | Minimum Capacity (SCFM) | Discharger Pressure (PSIG) | Minimum Motor Horsepower | Discharge Connection (inches) | Drive |
|---|---|---|---|---|---|---|
| B-201 | SBR #3 & #4 | 1300 | 11.1 | 100 | 8 | VFD |
| B-202 | SBR #3 & #4 | 1300 | 11.1 | 100 | 8 | VFD |
| B-203 | SBR #3 & #4 | 1300 | 11.1 | 100 | 8 | VFD |
| B-204 | SBR #3 & #4 | 1300 | 11.1 | 100 | 8 | VFD |
| B-205 | Digester #3 | 1300 | 11.1 | 100 | 8 | Constant Speed |
| B-206 | Digester #3 | 1300 | 11.1 | 100 | 8 | Constant Speed |
| B-207 | Digester #4 / SHT | 1300 | 11.1 | 100 | 8 | Constant Speed |
| B-208 | Digester #4/SHT | 1300 | 11.1 | 100 | 8 | Constant Speed |

B. The existing blower assemblies located in Building No. 3 are to be modified by the replacement of pulleys and sheaves to increase the blower speeds and capacity as shown on the drawings.

1.5 SUBMITTALS

A. Shop Drawings: Shop Drawings shall be submitted to the Engineer for approval per Section 01 33 01.
   1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.
   2. Certified factory test and transfer efficiency curves showing field performance for diffusers.
   3. Recommended spare parts list.

PART 2 PRODUCTS

2.1 BLOWER ASSEMBLIES:

A. Blower assemblies shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab 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.

B. Each blower assembly shall include the following components and accessories:
1. Blower
2. Inlet Filter /Silencer
3. Inlet Silencer
4. Discharge Silencer
5. Flexible Pipe Connector
6. Pressure Relief Valve
7. Discharge Check Valve
8. Discharge Butterfly Isolation Valve
9. Differential Pressure Gauge (0-20" W.C.)
10. Pressure Gauge (0-15 psi)
11. Vibration Isolation Pad (Cork Rib)

C. The SBR Blowers (B-201, B-202, B-203 and B-204) shall be provided with inverter duty motors for connection to variable speed drives provided with the motor control equipment to provide a variable air flow by speed adjustment controlled by dissolved oxygen within the SBR basins.

D. Each blower shall be of the horizontal rotary helical screw or twisted tri-lobe type blower. Axial flow and positive displacement type, providing oil-free air, suitable for heavy-duty continuous industrial service.

E. Casing shall be of close grain iron of one- or two-piece construction and must be precision doweled to each other for proper alignment. The casing shall be sufficiently ribbed to prevent distortion under service conditions.

F. Head plates shall be fabricated drive end and gear end head plates of close-grained cast iron which are precision machined for exact bearing housing fit.

G. Rotors shall be of the three-lobe helical design, and shall be of close-grained ductile iron, precision machined on all surfaces, dynamically balanced, and shall operate without rubbing, liquid seals, or air cylinder lubrication. Rotors must be solid for reduced vibration. Hollow rotors are not allowed due to unbalanced potential related to cavity built-up.

H. Helical alloy steel timing gears shall provide precise smooth rotor synchronization so that operating clearances are properly maintained. Spur tooth gears are not allowed.

I. Only piston ring air seals are allowed for leak-free operation and maximum seal life.

J. Oil seals may only be of the piston-ring type or the Inpro Seal premium oil seal. Lip seals are not allowed.

K. Gears and bearings shall be lubricated by a splash oil system for reduced maintenance and cooler operation. Grease lubrication is not allowed.

L. Flanges shall be flat faced and drilled and tapped in accordance with ANSI B16.1, 125/150# rating.

2.2 ELECTRIC MOTOR REQUIREMENTS

A. Constant torque, TEFC (IP55), 1800 RPM, 1.15 S.F., 460/3/60, class F insulation, certified for DOL starting and VFD service. Motors shall be as manufactured by Marathon, Baldor, WEG Electric or Toshiba.

B. Motor must be suitable for a v-belt drivetrain.

C. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA premium efficiency.

D. Frame must be cast iron and equipped with cooling fins. The motor feet shall be solid for better mechanical strength and reduced vibration. Aluminum and steel framed motors are not allowed. Skeletonized mounting feet are not allowed.

E. Conduit box must be cast iron, split diagonally and rotatable in 90° increments.

F. End shields shall be cast iron with fins for better thermal heat dissipation for lower bearing operating temperatures. They must be equipped with drain holes to expel water that may condense inside the frame in certain environments.

G. VFD operated motors to meet MGI Part 31 rating. VFD operated motors 100 HP and above must be equipped with an insulated bearing on the NDE and an AEGIS grounding ring on the DE.

2.3 BLOWER PACKAGE ACCESSORIES

A. General: The blower packages shall be fabricated and assembled with the following accessories and shipped complete to the extent feasible for safe shipping.

B. Equipment Base: The base shall be comprised of carbon steel plate and structural steel shapes and be of sufficient design to support the blower, motor, drivetrain and silencers without undue flexing. The base must be of a heavy-duty design to ensure operating vibration levels are within the blower manufacture's allowable tolerance. The blower and the motor are mounted in the horizontal configuration providing for vertical airflow and horizontally mounted silencers. The silencer may not be welded to the base in any way. All base frame structural welding to be per AWS D1.1. All welders must have a current welder qualification test record for AWS D1.1 issued by and AES accredited test facility with a certification no. All welder continuity logs must be up to date.

C. V-belt Drive: The blower-motor v-belt drivetrain must incorporate QD or taper-lock type bushings to secure the drive sheaves. Direct shaft mounted, bored-to-size sheaves are not acceptable. Cog-type v-belts are required in lieu of smooth-wrapped type construction.

D. Drive Guard: All mechanical power transmission drive components must be equipped with a steel guard sufficiently designed to protect personnel from accidental contact with moving parts. Guard(s) shall be securely mounted and designed for removal without the use of special tools. All belt drive guards shall be constructed to allow visual inspection of the sheaves and belts without removal. Guards shall be painted safety yellow or safety orange. Plastic / polymer guards are not allowed.

E. Filter: Provide each blower with a suitably sized air filter based on the filter manufactures published airflow capacity levels. Filters to be equipped with a weather hood for outdoor installations. Acceptable manufactures include Universal Silencer, Stoddard, Solberg or approved equal.

F. Intake Silencer: Provide a heavy-duty double shell cylindrical noise attenuation unit constructed of carbon steel sheet, tubing and plate. A combination chamber-absorptive type is required. The silencer must be multi-chambered for pulse control and shall contain internal acoustical packing material. The silencer must be independently supported and not welded to or integral with the base structure in any way. The silencer must be isolated from the blower connection by a flexible connector / expansion joint and not supported by the blower in anyway. Silencer to be Model RIS(Y) as manufactured by Universal Silencer or equal.

G. Discharge Silencer: Provide a heavy-duty double shell cylindrical noise attenuation unit constructed of carbon steel sheet, tubing and plate. A combination chamber-absorptive type is required. The silencer must be multi-chambered for pulse control and shall contain internal acoustical packing material. The acoustic packing material must have a minimum temperature rating of 300°F. The silencer must be independently supported and not welded to or integral with the base structure in any way. The silencer must be isolated from the blower connection by a flexible connector / expansion joint and not supported by the blower in anyway. Silencer to be Model SD(Y) as manufactured by Universal Silencer or equal.

   The discharge silencer in applications subject to pressures above 15.0 psi must meet the required ASME code construction requirements and be ASME code certified for it’s maximum pressure and temperature exposure.

H. Flexible Connector / Expansion Joints: A flex-conn / expansion joint is required directly at the inlet and discharge of the blower to provide vibration isolation, accommodate thermal expansion and eliminate loading of the blower cylinder. Three piece clamped sleeved type and one-piece arch type are both acceptable. Lateral, angular, elongation and compression tolerances must be suitable to accommodate thermal growth and component manufacturing tolerances. The minimum allowable rating for the inlet is 10 psi, 150°F. The minimum allowable ratings for the discharge is 25 psi, 300°F. Connector joints to be equivalent to Flex-Fab sleeve-type and General Rubber arch-type.

I. Pressure Relief Valve: Provide a spring or weighted type relief valve properly sized to protect the blower from over pressurization. The valve must be located downstream of the discharge silencer for pulsation protection. Provide valves equal to Sutorbilt weight-type and Kunkle spring-type.

J. Check Valves: Provide a full port dual plate 'butterfly style' check valve to be located downstream of the pressure relief valve. The body shall be steel or cast iron. The internals shall be corrosion resistant aluminum as a minimum. The hinge pin shall be stainless steel and the closure stop pin must be Teflon coated to provide for cushioned contact points. The valve shall be sized based on airflow as per the manufacture's recommendation to avoid chatter induced fatigue failures. Under-sized and over-sized valves are not permitted. The valve must be suitable for low pressure air. Pump valves and valves with external levers, springs or other control mechanisms are not permitted. Provide a valve equivalent to Flexi-Hinge Model 502M, 518, 503 or equal.

K. Discharge Isolation Butterfly Valve: Provide a wafer type, resilient seated, lever operated butterfly valve for isolating the blower from the system. Furnish valve with cast iron or ductile iron body and a corrosion resistant disc such as stainless steel, Aroxy coated or Nylon coated. The stem shall be stainless steel with a heavy-duty Acetal plug bushing. The seat elastomer to be EPDM or Viton. The hand lever must be equipped with position latching plate. Acceptable manufactures are DeZurik, DelVal, Keystone, Bray, Mueller, or approved equal.

L. Discharge Pressure Gauge: Provide 0-15 or 0-30 psi scaled pressure gauge to be stem mounted or panel mounted connected to the discharge side of the blower. Gauges not connected downstream of the discharge silencer require a pulsation snubber. Stem mounted gauges require a liquid filled case. The case shall be weather tight and be of corrosion resistant material such as stainless steel, aluminum, polysulfone or approved equal. Minimum size is 2-1/2" diameter and minimum accuracy to be +/- 2-1/2% of span per ASME B40.100 Grade 1A. Acceptable manufactures are Wika, Ashcroft or approved equal.

M. Inlet Restriction Gauge: Provide a low vacuum or differential pressure gage to be connected to the inlet side of the blower, downstream of the filter element. Acceptable ranges are 0-15 to 0-30 Inches H2O scale. Remote mounted and direct stem mounted are acceptable but must be easily viewable climbing. The case shall be weather tight and be of corrosion resistant material such as stainless steel, aluminum, polysulfone or approved equal. Minimum size is 2-1/2" diameter and minimum accuracy to be +/- 2-1/2% of span per ASME B40.100 Grade Acceptable manufactures are Dwyer, Ashcroft or approved equal.

## 2.4 SHOP PAINTING

A. Shop Prime Coating: Prime paint all components before assembly with an alkyd primer equivalent to Sherwin Williams Kem-Flash prime. Surface preparation, application and minimum DFT millage to be as per the paint manufactures published recommendation.

B. Shop Finish Coating: Finish paint all components before assembly with an enamel paint equivalent to Sherwin Williams Sher-Kem paint. Application and minimum DFT millage to be as per the paint manufactures published recommendation. Color to be the OEM's standard color or owner requested color.

## 2.5 SCADA MONITORING

A. The SBR Blowers (B-201, B-202, B-203 and B-204) shall be provided with remote dry contact outputs shall be provided for the plant SBR Control Panel and relay to the Plant SCADA system for the following:
   1. Blower Run Indication
   2. Blower motor temperature alarm
   3. Blower VFD Fault

B. The Digester Blowers (B-205, B-206, B-207 and B-208) shall be provided with remote dry contact outputs shall be provided for the plant Control Panel and relay to the Plant SCADA system for the following:
   1. Blower Run Indication
   2. Blower motor temperature alarm
   3. Blower HOA Out of Auto position

## 2.6 SPARE PARTS & LUBRICANTS

A. Equipment manufacturer shall furnish, for each piece of equipment, a one-year supply of the proper lubricants, of each type needed. This shall be in addition to the lubricants required for initial operation. Each type of lubricant shall be furnished in a separate sealed container that shall be clearly labeled showing the type of lubricant, equipment for which its use is intended, and instructions for use.

B. Spare Parts -The following spare parts shall be supplied by the SBR System equipment manufacturer:

C. 1 set inlet filters for each blower

# PART 3 EXECUTION

## 3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

## 3.2 INSTALLATION

A. Equipment shall be installed in strict accordance with the manufacturer’s instructions and approved shop drawings. All bolts, piping, valves, and appurtenances required for a complete installation shall be provided.

B. Service:
   1. Equipment manufacturer shall furnish all instruction and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, place the equipment in permanent operation, instruct the Owner's personnel in operation and maintenance, and perform field tests to insure proper operation.

2. A minimum of two (2) eight (8) hour days at the jobsite will shall be included for this service. A report of the field test results shall be provided and included in the final service manual. The report as a minimum shall contain performance information pertaining to blower voltage readings at the designated blower speed and related pressure. If there are difficulties in the operation of the equipment, additional service shall be provided at no cost to the OWNER.
3. After installation and final testing, the manufacturer shall provide written certification to the OWNER/ENGINEER that all equipment is properly installed and that the plant operators have been instructed on proper operation and maintenance procedures. Local manufacturer's representatives are not acceptable to perform these tasks.

## 3.3 WARRANTIES

A. Supplier will warranty all supplied equipment, for a period of one (1) year from the date of acceptance of the equipment by the OWNER.

END OF SECTION

SECTION 43 21 13
CENTRIFUGAL CHEMICAL PUMPS
(PUMP #P-513 & P-700)

## PART 1 GENERAL

### 1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the installation and startup of two (2) magnetic driven Tefzel® lined chemical pump complete with motor, base, controls and accessories as shown on the plans and specified herein.

B. Related Work
   1. See the following specifications for related work:
      a. Section 01 33 01 - Submittal Procedures, EPMS
      b. Division 26 - Electrical

### 1.2 REFERENCE STANDARDS

A. Pump, equipment and accessories shall be provided in accordance with the following reference standards as applicable.
   1. ASME B73.1M-1991 Horizontal End Suction Centrifugal Pumps
   2. Hydraulic Institute Standards (Latest Edition)
   3. American National Standards Institute (ANSI)
   4. American Society for Testing and Materials (ASTM)
   5. Anti-Friction Bearing Manufacturers Association (AFBMA)
   6. Institute of Electrical and Electronics Engineers (IEEE)
   7. National Electrical Manufacturers Association (NEMA)
   8. Underwriters Laboratories (UL)

### 1.3 SUBMITTALS

A. Shop Drawings shall be submitted to the ENGINEER for approval and shall include:
   1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.
   2. Wiring and schematic diagrams including accessories.
   3. Recommended spare parts list.
   4. Pump performance data including RPM, flow, head, efficiency, horsepower and NPSH.
   5. Certified component hydro test data.
   6. Certified pump material certificate of compliance
   7. Pump instruction manual
   8. Motor performance data
   9. Motor instruction manual

1.4 WARRANTY

A. The equipment shall be warranted for a period of 2 years after start-up not to exceed 18 months after shipment. The warranty shall cover re-adjustment, repair or replacement of any component found to be defective in design, material or workmanship.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment:
   1. The pump shall be a magnetically driven, seal less with zero leakage, Tefzel® lined chemical process pump.
   2. Pump shall meet ANSI B73.1M dimensions for all sizes for which standards apply and shall be provided in a Horizontal Close Coupled End Suction configuration.
   3. The pumping unit shall be complete including motor, controls and appurtenances. The pump shall be designed for continuous 24-hour operation free of overheating, vibration and cavitation. Each pump shall be provided with a stainless-steel nameplate. The nameplate shall include the pump model, size, serial number, lubrication type, impeller diameter, material of construction, RPM, GPM, TDH and maximum design pressure.

2.2 CONDITIONS OF OPERATIONS

A. Caustic Recirculation Pump (P-513) shall be designed for the conditions listed below:

- Liquid: Liquid sodium hydroxide (25%)
- Temperature °F Min: 45 degrees F; Max: 110 degrees F
- Specific Gravity: 1.28
- pH of 1% solution 14
- Capacity: 44 gpm
- Head TDH (Ft) Design: 22 ft; Min: 5 ft; Runout: 32 ft
- Minimum Efficiency % Design: 45%
- NPSHa Minimum: 15 ft
- Suction Pressure Min: 2 ft; Max: 14 ft
- Motor Design Data HP: 1.0; RPM: 1750
- PH/Hz/V: 3/60/460; Enclosure: TEFC

B. Polyaluminum Chloride Recirculation Pump (P-700) shall be design for the conditions listed below:

- Liquid: Polyaluminum Chloride (PAC) or Aluminum Sulfate (Alum)
- Temperature °F Min: 45 degrees F; Max: 110 degrees F
- Specific Gravity: 1.2
- pH or 1% solution 3.0 approximate
- Capacity: 44 gpm
- Head TDH (Ft) Design: 22 ft; Min: 5 ft; Runout: 32 ft
- Minimum Efficiency % Design: 45%

- NPSH Minimum: 15 ft
- Suction Pressure Min: 2 ft; Max: 14 ft
- Motor Design Data HP: 0.75; RPM: 1750
- PH/Hz/V: 3/60/460; Enclosure: TEFC

## 2.3 MAGNETIC DRIVEN PROCESS PUMP CONSTRUCTION

A. General:
1. The pump (s) shall be of a close coupled, end suction, seal less zero leakage, Tefzel® lined magnetic drive design for moderate to severe corrosive service.
2. The pump shall be ANSI dimensional for sizes which standards apply so that it may be replaced if required by other manufacturer's pumps without the need for piping or bedplate mounting modifications.
3. The pump shall have a double back pull-out design that allows maintenance on the motor and drive magnet assembly while the liquid end remains in the pump or allows maintenance on the internal components while the casing remains in the piping system.
4. Recirculation Circuit
   a. The recirculation circuit shall be a simple design for cooling & lubricating the pump radial & thrust bearings only. Pumps that require complex recirculation circuits to cool the containment shell or stator lining are not acceptable.
5. Casing:
   a. The casing shall be solid one-piece Ductile Iron with a Tefzel® lining construction. The flanges shall be ANSI dimensional 150# with a raised Tefzel® face. The flanges and casing feet locations shall also be ANSI dimensional. The Tefzel® lining shall be applied using a Rotolining process providing a uniform 1/8" thick lining that is bonded to the casing ensuring superior mechanical integrity. A flanged ½" casing drain with a raised Tefzel® face shall be provided. To maintain the integrity of the lining all other taps such as gauge taps are to be installed in the piping system. Linings that require dove tailing to lock the liner to the casing will not be accepted.
6. Impeller Magnet Assembly
   a. The impeller shall be an enclosed molded design. Impellers that are molded in two pieces with a separate front shroud will not be accepted. The impeller magnet assembly shall be either integrally molded with the impeller or pressed into the impeller housing. Magnet assemblies that are threaded onto the impeller will not accepted.
   b. The outer driving and inner driven magnets shall be made of high strength neodymium iron. The inner magnets shall be completely encapsulated in the magnet housing during the molding process, protected from the pumpage.
7. Impeller Shaft:
   a. The shaft on which the impeller rotates shall be a stationary design made of a diamond like coated pure sintered silicon carbide. The shaft shall be of a single piece, one diameter geometry to eliminate areas of stress. Shafts with shouldered reductions in diameter will not be accepted. The shaft shall be supported at both ends between the bearing spider and the containment shell to minimize deflection. Cantilevered shaft designs will not be accepted.
8. Liquid End Bearings:
   a. The radial bearing shall be made of silicon carbide with a diamond like coating to provide maximum abrasion resistance and protection against accidental dry running

occurrence. The bearing shall have a groove designed to eject solids out of the bearing and away from the containment shell area to prevent solids accumulation. Bearings greater than 1.5" in length shall be a two-piece design separated by a Teflon® spacer to provide a self-aligning, reduced stress under load feature. Bearings made of carbon or non-coated silicon carbide will not be accepted.

b. The thrust bearings shall be made of silicon carbide. Forward thrust shall be handled with a set of bearings mounted at the nose of the impeller and in the bearing spider. The bearing spider shall be made of solid Tefzel® and located in the suction of the pump to support the stationary shaft. The reverse thrust bearing shall be mounted in the containment shell.

9. Containment Shell:
   a. The containment shell shall be of Tefzel® lined, glass reinforced backed construction. The burst pressure rating shall be a minimum of two times the maximum pump design pressure. The inside of the containment shell shall be provided with ribs to promote circulation and to prevent deposits from accumulating. Containment shells that are constructed of metal, which generate heat due to magnetic losses resulting in a loss of overall efficiency will not be accepted.
10. O-Rings:
    a. O-ring material shall be compatible with the product being pumped. The containment shell to casing O-ring shall be shall be fully confined to prevent extrusion under operating conditions.
11. Motor Connection:
    a. Motors shall be close coupled to the pump to eliminate the requirement for pump / motor alignment.
12. Base Plates:
    a. The pump / motor unit shall be mounted on a solid, rigid, drip collecting, non-metallic, corrosion resistant base made of an epoxy based composite concrete polymer mix in compliance with ANSI / ASME B73.1M 1991 dimensional standards. The base shall feature a flatness of .001"/ft with inherent vibration dampening qualities. Stainless steel mounting inserts shall be molded in place to prevent tear out due to over torque. Steel bases and bases that are hollow and require filling with grout after installation will not be accepted.
13. Dry Run Protection:
    a. To prevent accidental dry run operation associated with unloading applications each pump shall be provided with the manufacturers recommended power monitoring device to shut down the motor when a reduce amp draw condition is encountered.

## 2.4 SHOP TESTING

A. Each pump shall be provided with a non-witnessed performance test in accordance with the standards of the Hydraulic Institute. A minimum of 5 points shall be taken including shut off, design point and runout.

B. In addition to the performance test, a non-witness hydrostatic test in accordance with the standards of Hydraulic Institute shall be performed. The test shall maintain a pressure of 1.5 times the maximum working pressure of the pump for 10 minutes.

2.5 SURFACE PREPARATION & SHOP PRIME COATING

A. The motor shall be provided with the manufacturer's standard severe duty corrosion resistant coating. The metallic parts of the pump shall be cleaned per the coating manufacturer's standards.

2.6 SPARE PARTS

A. The following spare parts shall be included for each pump.
   1. 1 Set of O-rings & Gaskets
   2. 1 Set of Bearings & Spacers
   3. 1 Set of Key's & Set Screws
   4. 1 Bearing Spider
   5. 1 Impeller Wear Ring
   6. 1 Casing with Drain Flange
   7. 1 Impeller Assembly with Inner Magnets
   8. 1 Stationary Shaft
   9. 1 Drive Carrier with Outer Magnets
   10. 1 Containment Shell

2.7 PUMP CONTROLS

A. The pump shall have local manual start / stop pushbutton controller.

PART 3 EXECUTION

3.1 Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All pipe connections to the pump shall be made without bending or stressing the piping to mate with the pump flanges. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided by the CONTRACTOR.

3.2 The equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of all equipment specified herein and in related sections. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, make adjustments as needed and place the equipment in permanent operation. Field tests shall be performed with the ENGINEER's present to insure proper operation. The following minimum items shall be checked by the manufacturer's representative and documented.

A. Proper rotation

B. Power supply voltage

C. Motor operating load and no-load current

D. Pump control operation

E. Pump capacity

3.3 After verification of proper performance, the service representative shall review with the OWNER and ENGINEER representatives, the equipment installed and demonstrate the operating methods and standard maintenance practices.

3.4 A letter from the manufacturer's representative confirming the equipment satisfactory installation and documenting the results of the field tests shall be submitted to the OWNER and Engineer prior to final acceptance of the pumps.

END OF SECTION

SECTION 43 21 29
CHEMICAL METERING PUMPS AND DILUTION SYSTEM
(PUMPS # P-505, P-506, P-507, P-508, P-509, P-702, P-703 & P-704)

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the installation and startup of positive displacement peristaltic type chemical metering pumps and automatic rotameter dilution water system including solenoid and pressure relief valves for feeding sodium hydroxide and polyaluminum chloride solutions as shown on the plans and specified herein.
2. The pumps shall conform to the following general characteristics:
    a. Pump shall be complete with spring-loaded pump heads, self-contained variable speed drives and flexible extruded tubes
    b. Peristaltic pumping action shall be created by the compression of the flexible tube between the pump head rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.
    c. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube and shall have a maximum suction lilt capability of up to 30-foot vertical water column. Maximum pressure rating: 100 psi.
    d. Pump shall not use check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.
    e. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed.

### 1.2 RELATED WORK

A. See the following specifications for related work:

1. Section 01 33 01 - Submittal Procedures, EPMS
2. Division 26 - Electrical

### 1.3 SUBMITTALS

A. Shop Drawings shall be submitted to the ENGINEER for approval and shall include:

1. Certified shop drawings.
2. Characteristic performance curve showing flow rate as a function of RPM and pressure.
3. Dimensional drawings.
4. Operating, maintenance, programming, and wiring instructions
5. P/10 ratio calculation.
6. Recommended spare parts list.

7. Pump instruction manual

## 1.4 QUALITY ASSURANCE

A. This specification is the basis for design of peristaltic metering pumps. All pumps, whether named as an acceptable supplier or submitted as an equal must, at a minimum, meet the specified critical design requirements.

B. To maximize pump efficiency and minimize tube fatigue that will impact life, performance, and accuracy, pumps must be designed not to exceed the specified P/10 ratio (Theoretical maximum number of occlusions per 10 gallons pumped). Pumps exceeding the specified P/IO ratio, will not be considered suitable for the duty condition. The following criteria is set to maintain the P/10 of ratio for the tube size specified for this application:
   1. Maximum two compressing rollers for two compressions per revolution.
   2. Tube wall thickness of 2.4 mm and material specified
   3. Large diameter spring-loaded roller set for 2.4mm wall thickness tubing
   4. Maximum base drive speed of 220 RPM for 2.4mm wall thickness tubing.
   5. Track geometry of no less than 180 degrees and rotor geometry with roller 180 degrees apart.

C. The P/10 ratio shall not exceed the following per tube size:

| Tube Size | P/10 ratio |
|---|---|
| 1.6mm x 2.4mm | 181,820 |
| 3.2mm x 2.4mm | 45,460 |
| 4.8mm x 2.4mm | 20,840 |
| 6.4mm x 2.4mm | 11,570 |
| 8.0mm x 2.4mm | 7,170 |
| 9.6mm x 2.4mm | 4,960 |

D. For quality assurance, all pump elements must be manufactured by the pump manufacturer in accordance with their specifications.

E. Drive and pump heads shall be rated for 24-hr continuous duty and have a five-year manufacturer's warranty from date of shipment.

F. Pumps shall be the manufacturer's standard product and the Manufacturer must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years in the same service as specified.

G. Pumps must be manufactured under ISO 9001-2000.

H. Pumps shall be meet all applicable CE and CETL US standards per UL6.101.01A

## 1.5 WARRANTY

A. The equipment shall be warranted for a minimum period of 1 year after from Owner acceptance and startup. The warranty shall cover re-adjustment, repair or replacement of any

component found to be defective in design, material or workmanship. The drive and pump head shall have a five (5) year warranty from date of shipment.

PART 2 PRODUCTS

2.1 PERISTALTIC PUMPS – POLYALUMINUM CHLORIDE (PAC).

A. The peristaltic pumps for Polyaluminum Chloride (PAC) shall conform to the following pump process schedule:

| | | | |
|---|---|---|---|
| Quantity | Three (3) | | |
| Tag Number(s) | P-702, P-703 & P-704 | | |
| Fluid<br>Viscosity<br>Specific Gravity<br>Fluid Temperature | Liquid Polyaluminum Chloride (PAC) or Aluminum Sulfate (Alum)<br>25 c[s @ 20ºC<br>1.32 – 1.35<br>Ambient | | |
| Tubing Material | Marprene II | | |
| Max — Min Capacity (GM) | 70 gph maximum – 0.25 gph minimum | | |
| Max Pump RPM for Application | 220 RPM | | |
| Tubing ID | 3.2 mm | 6.4 mm | 9.6 mm |
| Displacement /Revolution (Gallons) | 0.0005 | 0.0018 | 0.004 |
| P10 Ratio (Theoretical Maximum Number of Occlusions/10 Gallons Pumped) | 37,038 | 11,112 | 5,000 |
| Minimum Flow Rate (GPH) | 0.003 | 0.011 | 0.024 |
| Max Flow Rate (GPH) | 6.6 | 23.76 | 70 |
| Max Discharge Pressure (PSI) | 60 | 60 | 30 |
| Suction Head | Flooded Suction | | |
| Control | 4-20 mA signal from influent flow meter to control pump speed | | |
| Power (VAC, Frequency, Phase) | 1 I5VAC, 60 Hz, 1 Phase | | |

B. The Polyaluminum Chloride / Alum pumps shall include a control panel to control the operation of each feed pump/dilution system accepting a control 4-20 mA signal from the SCADA System for the headworks influent flow and deliver the power (120v) to the pumps and solenoids via HOA switches and input to the pump VFD for increasing and decreasing pumping rate in response to the influent flow rate.

2.2 PERISTALTIC PUMPS – SODIUM HYDROXIDE (CAUSTIC).

A. The peristaltic pumps for Sodium Hydroxide (caustic) shall conform to the following pump process schedule:

| | |
|---|---|
| Quantity | Five (5) |
| Tag Number(s) | P-505, P-506, P-507, P-508 & P-509 |

| | | | |
|---|---|---|---|
| Fluid<br>Viscosity<br>Specific Gravity<br>Fluid Temperature | 25% Sodium Hydroxide (Caustic)<br>7.9 c[s @ 68° F<br>1.28<br>60° – 80° F | | |
| Tubing Material | Marprene II | | |
| Max — Min Capacity (GM) | 55.5 gph maximum – 0.25 gph minimum | | |
| Max Pump RPM for Application | 220 RPM | | |
| Tubing ID | 3.2 mm | 6.4 mm | 9.6 mm |
| Displacement /Revolution (Gallons) | 0.0005 | 0.0018 | 0.004 |
| P10 Ratio (Theoretical Maximum Number of Occlusions/10 Gallons Pumped) | 37,038 | 11,112 | 5,000 |
| Minimum Flow Rate (GPH) | 0.003 | 0.011 | 0.024 |
| Max Flow Rate (GPH) | 6.6 | 23.76 | 52.8 |
| Max Discharge Pressure (PSI) | 60 | 60 | 30 |
| Suction Head | Flooded Suction | | |
| Control – P-505, P-506 & P-507 | On-Off signal from SBR control system based on pH of SBR's with pump speed manually set. | | |
| Control – P-508 & P-509 | Manual On-Off with pump speed manually set. | | |
| Power (VAC, Frequency, Phase) | 1 I5VAC, 60 Hz, 1 Phase | | |

B. The caustic metering pump shall be controlled as follows:

1. The caustic pumps designated for the SBR system shall include a control panel to control the operation of each feed pump/dilution system and shall be capable of accepting an on/off control signal from the pH monitoring system from the SBR SCADA System to control operation of the pumps and rotameter solenoids via HOA switches.
2. Each pump shall include a HOA switch permitting manual or automatic operation of the pump on the SCADA input signal. The caustic pump designated for either SBR #3 or #4 shall include a selector switch to designate either the SBR #3 or #4 control signal for controlling this pump.
3. Pumps designated for feeding the Digester #3, Digester #4 or Sludge Holding Tank #2 shall be operated on individual pump off/on switch with no automatic control.

## 2.3 PUMP CONSTRUCTION

A. Pump head

1. 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.

2. Pump head guard shall be transparent for purpose of viewing direction of rotation. For operator and environmental safety, pumps in which the direction of rotation cannot be visually verified are not acceptable.
3. Pump head Assembly
    a. Pump Track Geometry must have a minimum 96.6 mm swept diameter through a minimum track angle of 180 degrees.
    b. Provide high corrosion/impact materials as follows:
        1) Track Construction: polyphenylene sulfide (PPS)
        2) Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
        3) Rotor Construction: polyphenylene sulfide (PPS)
4. Tube Retainer Mechanism
    a. Provide two spring-loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pump head
5. Rotor Assembly
    a. Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance. Twin spring-loaded roller arms shall be located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution.
    b. Compressing Rollers shall be 316SS with low friction stainless steel bearings and PTFE seals and non-compressing guide rollers shall be constructed of corrosion resistant Nylatron.
    c. The rotor shall be equipped 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.
    d. To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.

## 2.4 TUBING

A. 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.

B. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with a 64 Shore A durometer and 2.4mm wall thickness or equal.

C. Pump shall be supplied with 6.4 mm tubing ID but shall readily accept tubing ID's of 3.2 mm, 6.4 mm or 9.6mm without pump adjustment or replacement. Tubing with a wall thickness less then 2.4mm is not acceptable. Supply 15-meter roll of the 6.4 mm tubing size.

## 2.5 DRIVE

A. Rating: Continuous 24-hour operation, 400 C ambient.

B. Supply: 110-.120V 50/60 Hz and 220-240V 50/60 I-Iz, 1-Phase field switchable with nine-foot length mains power cord with standard 115V three-prong plug.

C. Max drive power consumption: I35VA.

D. Enclosure: NEMA 4X

E. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat.

F. Pumps must meet the following minimum requirements for operator interface functionality.
   1. 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
   2. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming,
   3. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
   4. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
   5. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
   6. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm.

G. Auto control features shall include the following minimum features:
   1. Speed control by Analog 4-20mA or 0-10VDC with input signal trimmable and speed scaleable over any part of the drive speed range.
   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.
   3. Forward/Reverse Control: via 5V TTL, 24V industrial logic, or dry contact
   4. Auto/Manual Mode Control: via 5V TTL, 24V industrial logic, or dry contact
   5. Leak Detector Run/Stop Control: via 5V TTL, 24V industrial logic, or dry contact
   6. Status Outputs shall include four relay contacts rated for 30 VDC with maximum load of 30W, NO or NC software configurable to indicate Running/Stopped status, Forward/Reverse status, Auto/Manual status, General Alarm status or Leak Detected status.

H. Drive motor shall be a brushless DC motor with integral gearbox and tachometer feedback including:
   1. Speed Control Range of 2200:1 from 0.1 to 220 rpm +I- 0.1 rpm throughout the range.
   2. 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
   3. Circuitry complete with temperature and load compensation and protection.

I. Mounting: Drive shall be self-supporting and shall not require anchoring.

J. Leak detection shall be provided by a supply float-type leak sensor mounted to below the pump head for leak detection and pump shut down in the event of a tubing failure.

## 2.6 SPARES

A. One spare pump head assembly shall be provided

## 2.7 CHEMICAL DILUTION SYSTEM

A. A dilution system shall consist of manually adjusted rotameters, solenoid valves and pressure relief valves to automatically allow dilution water addition in concert with the operation of the metering pumps as shown on the drawings.

B. Rotameters
   1. The rotameters shall be heavy duty industrial rotameters with a capacity of 0.5 to 4.5 gpm of water with the following features:
      a. Borosilicate glass metering tube
      b. 316 Stainless Steel floats
      c. PTFE packing materials
      d. Aluminum side plates
      e. Safety glass windows with aluminum frames
      f. 9.8 inch detachable metal plate scale
      g. +/- 2 % accuracy
      h. Pipe connections ¾-inch FNPT
      i. Maximum pressure rating 100 psig

C. Solenoid Valves
   1. Two-way electric solenoid valves shall be provided to operate with the metering pumps allowing for dilution water to be added into the chemical process piping as shown on the drawings. The solenoid valves shall have the following features:
      a. Valves shall include an internal snubber to slow disc closing speed to reduce potential for water hammer.
      b. Valves shall be normally closed upon loss of power
      c. Minimum operating pressure differential between inlet and outlet port of 5 psi.
      d. Valves shall be UL listed and CSA certified and capable of handling water temperatures up to 180o F and 150 psi.
      e. Solenoid valves shall be constructed of CPVC (Chlorinated Polyvinyl Chloride), Type 4, Grade 1, cell classification conforming to ASTM D 1784 with EDPM O-rings and piston seals.
      f. Valves shall be 100% duty cycle NEMA IV approved for 19 watt coil and 0.75 amp with normal fail closed operation.
      g. Port size ¾-inch FNPT
      h. Vertical mounting

D. Pressure Relief Valves
   1. One-inch pressure relief valves shall be provided for protection of pumps and piping system against overpressure as shown on the drawings with the following features:
      a. CPVC Construction with no metal parts
      b. Adjustable relief pressure ranging from 0 to 75 psi with non-wetted, plastic coated spring.
      c. EPDM seals

d. Pressure gauge with range from 0-100 psi.
e. 1-inch threaded inlet and outlet connections.

PART 3 EXECUTION

3.1 Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All pipe connections to the pump shall be made without bending or stressing the piping to mate with the pump flanges. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided by the CONTRACTOR.

3.2 The equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of all equipment specified herein and in related sections. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, make adjustments as needed and place the equipment in permanent operation. Field tests shall be performed with the ENGINEER's present to insure proper operation. The following minimum items shall be checked by the manufacturer's representative and documented.

A. Proper rotation

B. Power supply voltage

C. Motor operating load and no-load current

D. Pump control operation

E. Pump capacity

F. Pressure relief valve operation

G. Solenoid valve operation for automatic addition of dilution water.

3.3 After verification of proper performance, the service representative shall review with the OWNER and ENGINEER representatives, the equipment installed and demonstrate the operating methods and standard maintenance practices.

3.4 A letter from the manufacturer's representative confirming the equipment satisfactory installation and documenting the results of the field tests shall be submitted to the OWNER and Engineer prior to final acceptance of the pumps.

END OF SECTION

SECTION 43 21 36
ROTARY LOBE SLUDGE PUMPS (P-504, P-510, P-511, P-512)

PART 1 GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals and shall perform all work necessary for the installation and startup of four (4) rotary lobe sludge pumps, motors, isolation rings, pressure gage, pressure switch and coordinated control system with variable speed drives integrated into control panel as shown on the plans and specified herein.

B. RELATED WORK

1. Section 01 33 01 - Submittal Procedures EPMS
2. Section 01 70 00 - Execution and Closeout Procedures
3. Section 09 90 00 - Painting - Process Equipment and Piping
4. Section 40 92 49 - Variable Frequency Drives
5. Section 44 46 16 - Rotary Sludge Press
6. Division 26 Electrical

C. REFERENCE STANDARDS

1. Design, manufacturing and assembly of elements of the equipment herein specified shall be accordance with the standards of the below listed organizations. Where reference is made to a standard of one of the following or other organizations, the version of the standard in effect at the time of the bid opening shall apply.
   a. American Gear Manufacturing Association (AGMA)
   b. American Institute of Steel construction (AISC)
   c. American Iron and Steel Institute (AISI
   d. American Society of Mechanical Engineers (ASME)
   e. American National Standards Institute (ANSI)
   f. American Society for Testing Materials (ASTM)
   g. American Water Works Association (AWWA)
   h. American Welding Society (AWS)
   i. Anti-Friction Bearing MANUFACTURERS Association (AFBMA)
   j. Hydraulic Institute Standards
   k. Institute of Electrical and Electronics Engineers (IEEE)
   l. National Electrical Code (NEC)
   m. National Electrical MANUFACTURERS Association (NEMA)
   n. Occupational Safety and Health Administration (OSHA
   o. Steel Structures Painting Council (SSPC)
   p. Underwriters Laboratories, Inc. (UL)

1.2 QUALIFICATIONS

A. To assure unity of responsibility, the pumps and motors shall be furnished and coordinated by the pump manufacturer (MANUFACTURER). The CONTRACTOR shall assume full responsibility

for the satisfactory operation of the entire pumping systems including pumps, motors, and controls as specified.

B. The equipment covered by these specifications shall be standard units of proven ability as manufactured by competent organizations having long experience in the production of such equipment. The pumps shall be the standard cataloged product of the MANUFACTURER. The pumps furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except as otherwise specified herein.

C. All Equipment furnished under this specification shall be new and unused and shall be the standard product of MANUFACTURERS showing a successful record of manufacturing and servicing the equipment and systems specified herein for a minimum of five (5) years.

D. The MANUFACTURER shall be fully responsible for the design, arrangement and operation of all connected rotating components of the assembled pumping unit to ensure that neither harmful nor damaging vibrations occur within the specified operating range. Design shall include fabricated steel base plate for mounting the units.

1.3 SUBMITTALS

A. Shop Drawings shall be submitted to the ENGINEER for approval and shall include:
   1. Certified shop and erection drawings showing all, important details of construction, dimensions and anchor bolt locations.
   2. Descriptive literature, bulletins and/or catalogs of the equipment.
   3. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity and horsepower. Curves shall be submitted on 8 ½" by 11" sheets, at as large a scale as is practical. Catalog sheets showing a family of curves will not be acceptable.
   4. A complete total bill of materials of all equipment (may be furnished with Operation and Maintenance manuals specified under paragraph 1.05).
   5. A list of the MANUFACTURER'S recommended spare parts with the manufacturer's current price for each item, shall be supplied. Include gaskets, packing, etc. on the list. List bearings by the bearings manufacturer's numbers only.
   6. Complete motor and control systems data.

B. Test Reports to be Submitted:
   1. A schedule of the date of shop testing and delivery of the equipment to the job site.
   2. Description of pump factory test procedures and equipment.
   3. Copies of all tests results, as specified.

C. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications. The maintenance instructions shall include trouble shooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

D. Submit the MANUFACTURER'S Certificate of Installation, Testing and Instruction.

E. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.4 OPERATING INSTRUCTIONS

A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

B. A trained instructor, with complete knowledge of proper operation and maintenance for all major components, shall be provided for two (2) days to instruct representatives of the OWNER and the ENGINEER on proper operation and maintenance. With the OWNER'S permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3. If there are difficulties in operation of the equipment due to the MANUFACTURER'S design or fabrication, additional service shall be provided at no cost to the OWNER.

1.5 TOOLS AND SPARE PARTS

A. One (1) set of all special tools required for normal operation and maintenance shall be provided. All such tools shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

B. Spare Parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage.

1.6 WARRANTY

A. All equipment supplied under this section shall be warranted for a period of one (1) years from startup by the CONTRACTOR and the MANUFACTURER. Distributor warranties will not be acceptable.

B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the OWNER.

PART 2 PRODUCTS

A. GENERAL
   1. All equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain.
   2. The Rotary Lobe Pumps shall be designed to be abrasion resistant for applications in wastewater treatment plants. The pump shall have a minimum displacement of 47 gal / 100 revolutions.
   3. The ratio of the axial length of the lobe as compared to the lobe diameter (length / diameter) shall not exceed 1.0.

4. The pumps shall be of the positive displacement, rotary lobe type, designed to pump wastewater sludge.
5. All fluid-wetted parts including the mechanical seal shall be replaceable through the quick release front cover without disassembly of coupling, drive unit or the pipe system.
6. The pumps shall be designed to temporarily run dry and to operate in either direction. Oil-quench for protection of the mechanical seal is mandatory. Seal water flush systems are not acceptable.
7. The pumps shall be constructed with an oil-filled intermediate chamber between the pump casing and the gearbox with the following functions:
    a. Oil-Quench (Lubrication and cooling) of the mechanical seals
    b. Detection of seal failures
    c. Buffer zone to the sealed timing gear
8. Oil drain of gearbox and intermediate chamber shall be easily accessible with side mounted drain screw. Oil drain under the pump is not acceptable.
9. The rotor/shaft connection shall be oil-lubricated fed by an intermediate chamber and shall not come in contact with the pumped fluid.

B. The pumping units required under this section shall be complete. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed. Ample room for inspection, repairs and adjustment shall be provided.

C. Stainless steel nameplates giving the name of the MANUFACTURER, the rated capacity, head, speed and all other pertinent data shall be attached to each pump, motor, and control panel.

D. All working parts of the pumps and motors, such as bearings, wearing rings, shaft, sleeves, etc., shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the OWNER may, at any time in the future, obtain replacement and repair parts for those furnished in the original machines.

E. The nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed.

F. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA regulations. Galvanized steel guards shall be installed on all rotation assemblies. The noise level of motors, unless otherwise noted, shall not exceed 85 dBA measured 3 meters from the unit under free field conditions while operating on utility power.

G. All lubrication fitting shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards.

2.2 PUMPS

A. The pumps shall be of the positive displacement, rotary lobe type designed to be abrasion resistant for wastewater application and pump up to 10% solids.

B. OPERATING CONDITIONS:

| | Rotary Drum Thickener Discharge Pumps (P-504) | Rotary Filter Press Sludge Pumps (P-510, P-511 & P-512) |
|---|---|---|
| Primary Duty Point | 200 gpm | 120 gpm |
| Differential Pressure | 30 psi | 50 psi |
| Suction Conditions | 0-5 feet | 0-21 feet (flooded) |
| Medium | Thickened Waste Activated Sludge | Aerobically Digested Waste Activated Sludge |
| Percent of Solids | 0.5 – 7% | 1 - 3% |
| Maximum HP at Duty Condition | 7.5 Hp | 7.5 Hp |
| Suction and Discharge Flange Size | 4-inch | 4-inch |
| NPSHR shall not exceed | 6.0 Ft | 6.0 Ft |
| Shaft Deflection Shall Not Exceed | 0.0005 inch | 0.0005 inch |
| Maximum pump RPM shall be | 450 RPM | 350 RPM |
| Minimum volumetric efficiency | 84% | 84% |
| Control | On-Off control by level switch in RDT receiving hopper with manually adjusted speed at pump. | Variable speed controlled from RFP controls. |

C. Pump Construction:
   1. The pump casing shall be manufactured in a single block construction (Cast iron ASTM A48 grade 40, Brinell hardness 264 Brinell). Multiple Piece Design Pump Casings held together by screw connections are not acceptable.
   2. The rear of the pump casing and the front cover shall be protected with replaceable wear plates with a hardness of 550 Brinell. The front cover protection plate shall be reversible.

The pump casing shall be equipped with radial pump casing protection plates, which are less expensive and will eliminate the pump casing as a spare part for reduction of the Life Cycle Costs of the pump unit. Pump casings without radial liners are not acceptable.

3. The quick release cover shall be held in place by four eye nuts. The stationary threaded studs shall keep the front cover on the same level as the pump casing in the process of opening the pump for easy handling.
4. Rotors shall be tri lobe screw rotor design and shall consist of a non-sludge-wetted cast iron core entirely coated with abrasion-resistant Buna-N. Stacking of lobes is not acceptable. Rotors shall be keyed to the shaft with one central screw to a cylindrical thread inside the shaft. The cast iron core of the rotor shall be equipped with a female thread to enable the removal of the rotor from the shaft with ease.
5. The shafts shall be non-sludge-wetted, the rotor / shaft connection shall be lubricated with quench fluid of the intermediate chamber. They shall be timed in their rotation by straight cut timing gears running in a separate oil chamber, which also contains the ball and roller bearings for each shaft. Sludge wetted rotor / shaft connections are not acceptable. The shafts shall be constructed from carbon steel AISI 4140.
6. The pumps shall be fitted with maintenance free, quenched mechanical seals with Duronit or Silicon Carbide seal faces. The seals shall be operating in a common oil-filled intermediate chamber (Quench for lubrication and cooling). Purge systems for the seals are not acceptable. The rotating holding bush shall be locked in a fixed radial position by a keyway that also holds the rotor in place. Seal designs that open during rotor replacement are not acceptable. No sleeves shall be necessary for the mechanical seal set up. Design of the pump shall allow removal and replacement of the seal via the front cover.
7. Bearings and timing gear shall be located in a common oil-filled cast iron gearbox, fitted with a built-in sight class to monitor oil level. The timing gear shall maintain non-contact between the rotors. Bearing life to be designed for L-10 bearing life rating of 100,000 hours at design conditions.
8. Suction and discharge connections from galvanized steel shall be 4” ANSI 150-pound flanges.
9. Pump and drive fitted on common base, made from galvanized steel.
10. Vibration: Pumps and motors shall operate at any point within their operating range without undue noise and vibration. Vibration at any point in the operating range shall not exceed the limits allowed by the Hydraulic Institute.

## 2.3 SPARE PARTS

A. The following spare parts shall be provided with each pump:
   1. One (1) set of cartridge mechanical seals and O-rings.
   2. One (1) Set of lobes and O-rings.
   3. One (1) Set of axial protection plates.
   4. One (1) Set of radial liners (if not provided include pump casing).

## 2.4 MOTORS

A. The motors shall consist of a geared motor configuration and shall be supplied with an in-line reducer complete with electric motor, 7.5 HP, 1800 RPM, 3 phase, 60 Hz, 460 volt, TEFC, 1.15 SF, Class F Insulation.

B. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable.

C. The motors supplied shall be specifically designed for inverter duty compatible with the variable frequency drives.

## 2.5 CONTROL SYSTEM

A. Automated control of the respective rotary lobe pumps shall be coordinated as follows:
   1. Thickened Waste Activated Sludge Pumps (P-29 and P- 503) –
      a. Rotary Drum Thickener (Section 46 71 33) to allow operation and automated speed adjustment based an output signal from the Rotary Drum Thickener control panel.
      b. An ultrasonic level control shall be provided in the rotary drum thickener sludge feed hopper for monitoring the level of dewatered sludge and providing input to the motor VFD for controlling the speed of the rotary lobe pump to speed up with increasing level, turning off pump at low level and initiation of pump when the sludge level reaches a predetermined level.
      c. The rotary drum control panel shall be equipped SCADA signals (dry contacts) wired to terminals located in the control panel for the following minimum signals:
         1) RDT Sludge Pump HOA Not in Auto Condition.
   2. Rotary Filter Press Pumps (P-510, P-511 & P-512) -
      a. Rotary Sludge Press (Section 44 46 16) to allow operation and automated speed adjustment based upon a 4-20 mA output signal from the rotary sludge press control system. The controls for operation of the pumps are to be integrated into the Rotary Sludge Press by the RSP supplier.
      b. An output closure shall be provided for automatic operation of the existing Macerator with the pump in the auto mode.
      c. The pump shall be electrically interlocked with a pressure switch located in the discharge piping to automatically terminate pump operation when the discharge pressure exceeds an adjustable pressure setting from 50 to 100 psi.
      d. The control panel shall include hand/off/auto (HOA) switches for each pump, LED pilot run lights (green) for each pump, non re-settable elapsed time meter, NEMA starters, breakers, strip heater for condensation control and pressure indicators within each system.
      e. Remote dry contact outputs shall be provided for each pump for the plant SCADA system for the following:
         1) Pump operation
         2) Pump high temperature alarm
         3) Pump high pressure alarm

## 2.6 PUMP HIGH PRESSURE PROTECTION EQUIPMENT AND INSTRUMENTATION (P-510, P-511 & P-512)

A. Each Rotary Filter Press pump shall be supplied with an isolation ring, pressure switch and pressure gage for high pressure protection of the pumps and piping system:

B. Isolation rings (Red Valve Series 40 or equal) for installation in 4" diameter DIP piping with the following features:

1. Carbon Steel Housing with 360 degree cylinder for mounting between ANSI B16.5 Class 150 flanges
2. Inner flexible wall of Buna N or EDPM Elastomers compatible with sewage sludge.
3. Ethylene Glycol and water captive sensing fluid

C. Pressure switches shall be full-port, non-clogging design with a local display and transmitter output of 4-20 mA for continuous monitoring of discharge pressure and with adjustable set point for pump control (Red Valve Company Digital Pressure Switch or equal).

2.7 ELECTRICAL DEVICES AND CONTROLS – RDT DISCHARGE PUMP

A. A NEMA 4X standard control panel with 3-point latch, suitable for wall or stand mounting, fabricated of 304 stainless steel shall be provided with the RDT Sludge Discharge Pump containing:
1. Main disconnect.
2. On/Off push button.
3. VFD with 10:1 potentiometer to accommodate 460 V, 3 Phase input power for the RDT sludge pump.
4. Auto mode for remote control from RDT control panel.

B. A laser level control shall be provided with RDT in the sludge feed hopper for monitoring the level of thickened sludge and providing input to the RDT pump motor VFD for controlling the speed of the pump up with increasing level, turning off pump at low level and initiation of pump when sludge reaching a predetermined level.

PART 3 EXECUTION

A. INSTALLATION
1. Pumps shall be installed in strict accordance with the MANUFACTURER'S instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the MANUFACTURER'S recommendations. Anchor bolts shall be set in accordance with the MANUFACTURER'S recommendations.
2. Upon completion of the installation, the CONTRACTOR shall submit a certificate from the MANUFACTURER stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and are of each unit.

B. PAINTING
1. Prior to shop painting all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter. All exposed portions of the pumps and motors shall be shop primed with primer compatible with field painting as specified.
2. Field painting shall be as specified in Section 09 90 00 of this specification. The primer and paint used in the shop shall be products of the same MANUFACTURER as the field paint to assure compatibility.
3. All nameplates shall be properly protected during painting.

C. INSPECTION AND TESTING
1. Factory Testing:
a. The ENGINEER shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of the manufacture. The ENGINEER shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the ENGINEER if desired.
b. All pumps shall be factory tested in accordance with the standards of the Hydraulic Institute. Certified pump performance curves shall be submitted, including head, capacity, and brake horsepower, for each pump supplied.
c. Prior to conducting factory pump tests, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least ten working days before the schedule test date. All electronic transducers, meter, gauges, and other test instruments shall have been calibrated in accordance with the requirements of the Hydraulic Institute Standards. Copies of calibration data shall be provided.
d. All pumps shall be factory tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency.
e. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the efficiency requirements at any of the listed flow or head conditions listed and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with units(s) which meet the specified requirements.

D. FIELD TESTS:
1. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
2. The CONTRACTOR shall furnish the services of the MANUFACTURER'S field service technician, who has complete knowledge of proper operation and maintenance of the equipment, for a period of not less than one (1) day, (8) eight hours, to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel. The first visit shall be checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test.
3. A portion of the startup time shall be allocated solely to instruction of plant personnel in operation and maintenance of the equipment. The instruction period shall be scheduled at least 10 days in advance with the OWNER and shall take place prior to start up and acceptance by OWNER. The final copies of operation and maintenance manuals specified must be delivered to the ENGINEER prior to scheduling the instruction period.
4. Field tests shall be performed in the presence of the ENGINEER as necessary to indicate that the pumps and motors conform to the operating conditions specified. A 30-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the specified requirements, corrective measures shall be taken. All test procedures shall be in accordance with factory test procedures specified above and certified results of tests shall be submitted. The CONTRACTOR/Manufacturer shall provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the ENGINEER for approval 30 days prior to testing.

5. Noise and vibration tests shall be conducted in conformance with the Hydraulics Institute Test Codes and OSHA Standards of Occupational Noise Exposure. The actual natural frequency of the installed pumping units will be verified using industry accepted procedures.
6. All pumps operating settings, alarms, controls, and shutdown devices shall be calibrated and tested during the field tests.
7. The electric control system, pressure detection system and alarms shall be test operated for proper functioning prior to the pump mechanical test. The control system shall be checked out using simulated operating signals as per pump MANUFACTURER'S recommendations.
8. The CONTRACTOR shall check all drives for correct clearances, alignment and lubrication in accordance with MANUFACTURER'S instructions. The CONTRACTOR shall check direction of rotation of all motors and reverse connections if necessary.

END OF SECTION

SECTION 43 21 39
SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the installation and startup of submersible centrifugal pumps as shown on the plans and specified herein.

1.

1.2 Related Work

See the following specifications for related work:

| | | |
|---|---|---|
| 1. | Section 01 33 01 - | Submittal Procedures EPMS |
| 2. | Section 01 70 00 - | Execution and Closeout Procedures |
| 3. | Section 40 97 00 - | Pump Control Panels |
| 4. | Section 44 46 10 - | Sequencing Batch Reactor & Aerobic Digestion Equipment |
| 5. | Division 26 - | Electrical |

1.3 BASIS OF DESIGN

The basis of design and operating conditions for the respective pumps is provided in the pump schedule provided in Part 4 of this specification.

Pumps directly associated with and controlled at the sequencing batch reactor, aerobic digesters and sludge holding tank control panel shall be supplied by the Sequencing Batch Reactor and Aerobic Digester equipment supplier to ensure process compatibility and uniformity.

1.4 QUALITY ASSURANCE

The submersible pumps shall be of the Xylem Flygt or approved equal to meet the process requirements.

The referenced manufacturer(s) is named to establish standards of quality. Equal products of other manufacturers complying with these specifications may be provided as an alternative for the Owner's consideration.

1.5 SUBMITTALS

Shop Drawings shall be submitted to the ENGINEER for approval to include:

1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.
2. Factory test and characteristic curves showing field performance for each pump.
3. Wiring and schematic diagrams including accessories.
4. Recommended spare parts list.

PART 2

2.1 PUMP DESIGN

The pump(s) shall be of the vertical configuration design, automatically and firmly connected to the discharge connection, guided by no less than two (2) parallel guide bars extending from top of the basin to the pump base mounted discharge connection. There shall be no need for personnel to enter the basin for pump removal and reinstallation. Sealing of the pumping unit to the discharge connection shall be by a machined metal to metal watertight contact. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the basin floor directly or on a sump floor mounted stand.

Each pump shall be fitted with a minimum of four (4) feet of lifting chain, twenty-five (25) feet of stainless steel cable and a chain grabber connection for connection to the pump lifting chain.

Equalization (EQ) Transfer Pumps (P-206, P-207, P-208, P-209, P-210) shall have variable speed pumps with the necessary characteristics to permit adjustment of pump speed in response to a 4 - 20 mA signal from a Post Equalization Basin level. Each pump shall be properly selected to perform under the specified operating characteristics.

## 2.2 PUMP CONSTRUCTION

The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 35B. The pump discharge shall be fitted with a standard ASA 125 lb. flange, faced and drilled to connect with the discharge elbow. All nuts and bolts fasteners exposed to the pumped liquids shall be AISI type 304 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester paint finish on the exterior of the pump.

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile rubber O-rings. Joint sealing shall be the result of controlled compression of fitted O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

## 2.3 Cooling System

Pumps with motors shall be sufficiently cooled by the surrounding environment or pumped media and shall not require a cooling jacket.

## 2.4 Cable Entry Seal

The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the cable entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function.
The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

## 2.5 Motor

Constant speed pumps shall have a U/L listed, hermetically sealed, submersible type electric motor designed for use in hazardous locations designated for Class I, Division I, Group D and general use in pumping sewage. The motors shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class F insulation rated for 155°C (311°F). Motors shall be energy efficient inverter duty motors with Class H insulation complying with NEMA MG-1, Part 31. The motors shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of at least 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum.
Three (3) thermal switches shall be embedded in the stator lead coils to monitor the temperature of each phase winding. The thermal switches shall be used in conjunction with and supplement to external motor overload protection and shall be connected to the control panel.
The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression or O-ring seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board.
The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no load characteristics.
The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the pump junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated

polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut off through run out.

2.6 Bearings

The pump shaft shall rotate on two grease-lubricated bearings. The upper bearing, provided for radial forces, shall be a single roller bearing. The lower bearings shall consist of two rows of angular contact bearings to compensate for axial thrust and radial forces. The minimum $L_{10}$ bearing life shall be 50,000 hours at any usable portion of the pump curve.

2.7 Mechanical Seal

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal.
Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.
The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

2.8 Pump Shaft

Pump and motor shaft shall be a solid continuous shaft. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be of stainless steel - ASTM A431 S43100-T and shall be completely isolated from the pumped liquid.

2.9 Impeller

The impeller(s) shall be Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multiple vane, back swept, screw-shaped, non-clog design.
The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater.
The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater.
The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

2.10 Volute / Suction Cover

Pump volute(s) shall be single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages large enough to pass solids up to 3-inches in diameter that may enter the impeller. Minimum inlet and discharge size shall be as specified.

The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.11 Protection

All stators shall incorporate three thermal switches, connected in series, to provide over temperature protection of the motor winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm.
A leakage sensor shall be provided to detect water intrusion into the stator chamber and junction chamber. A Float Leakage Sensor (FLS), a small float switch, shall be used to detect the presence of water in either the stator chamber or junction chamber. When activated, the FLS will stop the motor and activate an alarm both local and remote.
The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

2.12 Pump Control System

The pump control panel or system shall be supplied by the equipment supplier designated in the pump schedule provide in Part 4 of this specification.
Controls shall be complete with all control components, starters, relays, contacts, etc.
All control components shall be manufactured in the United States.

2.13 Sequence of Operation

Sequencing Batch Reactor (SBR) and Aerobic Digestion Equipment -

1. Controls for all pumps supplied as part as part of the SBR and Aerobic Digestion equipment shall be controlled through the system controls or local H/O/A controls at the respective pumps.
2. Operational sequence shall be the responsibility of the system supplier.
3.

Post Equalization Transfer Pumps Operational Sequence -

4. The Post Equalization Tank receives a series of high volume, interval discharges from the two SBR basins. The objective of the Post Equalization Transfer Pump system is to provide an equalized constant flow to the downstream effluent filters and UV system by automatically adjusting the pump speed to compensate for changes in the pump discharge head. Based upon the average daily plant flow, the operator will select a maximum and minimum pump speed corresponding to the desired pumping rate for the respective minimum and maximum discharge head conditions.
5. As the water elevation rises to the "lead pump start" elevation in the Post Equalization Tank, the Lead Pump shall start at the preset maximum operating speed and progressively ramp down to a preset minimum operating speed at the "high level" elevation.
6. Lag Pump No. 1 shall start a preset intermediate elevation and ramp up to the speed of the Lead Pump. The Lag No. 1 Pump shall continue to ramp speed up or down in response to the tank elevation similar to that of the Lead Pump.
7. In the event the Lead and Lag No. 1 Pumps operating together are unable to maintain the Post Equalization Tank water elevation below a preset high level, the Lag No. 2 Pump shall be activated at the high level and ramp up to the same speed as the operating pump(s).
8. In the event the Lead and Lag No. 1 and Lag No. 2 Pumps operating together are unable to maintain the Post Equalization Tank water elevation below a preset high level, the Lag No. 3 Pump shall be activated at the high level and ramp up to the same speed as the operating pump(s).
9. In the event the Lead and Lag No. 1, 2 and 3 Pumps operating together are unable to maintain the Post Equalization Tank water elevation below a preset high level, the Lag No. 4

Pump shall be activated at the high level and ramp up to the same speed as the operating pump(s).

10. When the basin "pump off" elevation is achieved by the operating pumps, all pumps shall stop and the pumps rotated such that Lag No. 1 Pump becomes the Lead Pump, and the other Lag Pumps move up in the rotation with the former Lead Pump becoming Lag Pump No. 4.

2.14 Auxiliary Equipment

A. Intermediate Guide Bar Brackets and hardware shall be provided as recommended by pump manufacturer for support of the pump removal guide bars off the discharge piping. Brackets and hardware shall be 304 stainless steel.

B. Upper Guide Bar Brackets and attachments shall be provided for securing guide bars to the structure. The guide bar shall be designed to allow the pump removal without removal of any bolts or connections. All components and anchor bolts shall be 304 stainless steel.

C. Grip Eyes shall be provided for each pump for griping the chain section attached to the pump for removal by an overhead hoist without regripping during pump removal. Grip eyes shall be constructed of wrought alloy steel.

D. Chain slings shall be provided for each pump for removal using the grip eye retrieval. The chain sling shall extend a minimum of four (4) feet above the pump and shall include all attachments shackle hardware. Chain and hardware shall be 304 or 316 stainless steel.

E. Each pump shall be fitted with sufficient stainless-steel cable for carrying the grip eye to the chain sling at the pump.

F. A cable holder, constructed of stainless steel with attachment hardware, shall be provided at each pump location for securing power cords and pump cables. All attachment hardware shall be 304 stainless steel.

G. Properly sized davit cranes as shown on drawings complete with pedestal base, spur gear hand winch and stainless-steel finish shall be provided for each pump location as shown on the drawings.

## PART 3 EXECUTION

3.1 Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided by the CONTRACTOR.

3.2 The equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of all equipment specified herein and in related sections. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation; make adjustments to the PLC controller as required.

3.3 Field tests shall be performed with the ENGINEER's present to insure proper operation. The following minimum items shall be checked by the manufacturer's representative and documented:

- Stator and power cables
- Seal lubrication
- Proper rotation
- Power supply voltage
- Motor operating load and no-load current
- Pump control operation and sequence
- Pump capacity

3.4 A minimum of one (1), eight (8) hour day in one trip shall be provided for system startup, integration and operator training.

3.5 After verification of proper performance, the service representative shall review with the OWNER and ENGINEER representatives, the equipment installed integrated into the system, procedures for adjustment of flow rates and demonstrate the operating methods and standard maintenance practices.

3.6 A letter from the manufacturer's representative confirming the equipment satisfactory installation and documenting the results of the field tests shall be submitted to the OWNER and Engineer prior to final acceptance of the pumps.

3.7 A minimum of one (1), eight (8) hour day in one trip shall be provided for system startup, integration and operator training.

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3.9 A letter from the manufacturer's representative confirming the equipment satisfactory installation and documenting the results of the field tests shall be submitted to the OWNER and Engineer prior to final acceptance of the pumps.

PART 4 PUMP SCHEDULE

4.1 The Contractor shall be responsible for supplying the pumps listed in the below table and the related auxiliary equipment and controls required.

Table 2.17.1 Submersible Pumps

| Pump ID | Location | Capacity (gpm) | Static Head (ft) | Total Head (ft) | Discharge Size (in.) | Horse Power** | Max/ Speed (rpm) | Control | Power Cable (Ft) | Power |
|---|---|---|---|---|---|---|---|---|---|---|
| JP-201 | SBR #3 | 6590 | Flooded | 19 | 14 | 60 | 885 | SBR C.P. | 50’ | 460 / 3 Ph |
| JP-202 | SBR #3 | 6590 | Flooded | 19 | 14 | 60 | 885 | SBR C.P. | 50’ | 460 / 3 Ph |
| JP-203 | SBR #4 | 6590 | Flooded | 19 | 14 | 60 | 885 | SBR C.P. | 50’ | 460 / 3 Ph |
| JP-204 | SBR #4 | 6590 | Flooded | 19 | 14 | 60 | 885 | SBR C.P | 50’ | 460 / 3 Ph |
| JP-205 | Digester #3 | 2929 | Flooded | 19 | 8 | 25 | 1160 | SBR C.P | 50’ | 460 / 3 Ph |
| JP-206 | Digester #4 | 2929 | Flooded | 19 | 8 | 25 | 1160 | SBR C.P | 50’ | 460 / 3 Ph |
| JP-207 | Digester #4 | 2929 | Flooded | 19 | 8 | 25 | 1160 | SBR C.P | 50’ | 460 / 3 Ph |
| JP-208 | SHT #2 | 2929 | Flooded | 19 | 8 | 25 | 1160 | SBR C.P | 50’ | 460 / 3 Ph |
| P-201 | SBR #3 (WAS)<br>2nd Cond. | 700<br>800 | 12.1<br>12.1 | 26<br>23 | 6 | 10 | 1740 | SBR C.P | 50’ | 460 / 3 Ph |
| P-202 | SBR #4 (WAS)<br>2nd Cond. | 700<br>480 | 12.1<br>12.1 | 26<br>33 | 6 | 10 | 1740 | SBR C.P | 50’ | 460 / 3 Ph |
| P-203 | Digester #3<br>2nd Cond. | 700<br>480 | 14.7<br>26.5 | 26<br>33 | 6 | 10 | 1740 | SBR C.P | 50’ | 460 / 3 Ph |
| P-204 | Digester #4<br>2nd Cond. | 700<br>850 | 14.0<br>4 | 25<br>20 | 6 | 10 | 1740 | SBR C.P | 50’ | 460 / 3 Ph |
| P-205 | SHT #2<br>2nd Cond | 700<br>550 | 1.5<br>15.5 | 24<br>30 | 6 | 10 | 1140 | SBR C.P | 50’ | 460 / 3 Ph |
| P-206 | Post-EQ Basin | 1150 | Varies<br>4.3 to 15.3 | Varies<br>11.6 to 22.6 | 6 min | 7.4 | 1740<br>Variable | Local Panel<br>@ Post EQ | 60’ | 460 / 3 Ph |
| P-207 | Post-EQ Basin | 1150 | Varies<br>4.3 – 15.3 | Varies<br>11.6 to 22.6 | 6 min | 7.4 | 1740<br>Variable | Local Panel<br>@ Post EQ | 60’ | 460 / 3 Ph |
| P-208 | Post-EQ Basin | 1150 | Varies<br>4.3 – 15.3 | Varies<br>11.6 to 22.6 | 6 min | 7.4 | 1740<br>Variable | Local Panel<br>@ Post EQ | 60’ | 460 / 3 Ph |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| P-209 | Post-EQ Basin | 1150 | Varies<br>4.3 – 15.3 | Varies<br>11.6 to 22.6 | 6 min | 7.4 | 1740<br>Variable | Local Panel<br>@ Post EQ | 60’ | 460 / 3 Ph |
| P-210 | Post-EQ Basin | 1150 | Varies<br>4.3 to 15.3 | Varies<br>11.6 to 22.6 | 6 min | 7.4 | 1740<br>Variable | Local Panel<br>@ Post EQ | 60’ | 460 / 3 Ph |
| *Listed capacity and horsepower are minimum. Listed speed is maximum. | | | | | | | | | | |

SECTION 43 32 63
ULTRAVIOLET DISINFECTION EQUIPMENT (UV-3 & UV -4)

PART 1 GENERAL

1.1 SUMMARY

A. DESCRIPTION

1. The CONTRACTOR shall furnish all labor, materials, equipment and services for the complete and satisfactory installation of an open channel, gravity flow, ultraviolet (UV) disinfection system compatible with the existing Xylem - Wedeco operating system. The system shall be complete with UV modules, power distribution, system control, UV detection system, automatic lamp wiping system, effluent weir, two (2) portable hoists for UV module maintenance, aluminum covers to match existing system covers and actuators for automated operation of existing slide gates, as shown on the contract drawings and specified herein.
2. The UV system shall be a "low pressure, high intensity, amalgam type lamps" with a new lamp rated output of 150 watts UV-C (254 nm) per lamp, measured with lamps having operated for 100 hours.
3. The system shall utilize active control based on the following dose parameters:
   a. Lamp output intensity
   b. Quartz sleeve transmittance
   c. Water quality transmittance
   d. Water flow

   Based on these parameters, the system will automatically vary the UV lamp power proportionally to the dose requirement. Systems that take only flow and water transmittance into account are not acceptable.
4. The dose delivered by the UV system shall be linearly variable within a range of 50% to 100% of maximum power in both manual and automatic operating modes. If the variability differs between modes, the automatic mode of operation shall be the sole mode considered. Power variation in "steps" shall not be permitted.
5. The system shall be capable of continuous disinfection while automatically cleaning the UV lamp sleeves without reducing or shadowing the output of the lamps.
6. All assembly hardware such as bolts, washers, nuts, and jam nuts shall be furnished by the CONTRACTOR.
7. The stainless steel support braces and saddles for mounting the system shall be furnished and installed by the CONTRACTOR in conformance with the UV system manufacturer's minimum requirements.

1.2 RELATED WORK

A. See the following specifications for related work specified elsewhere:

1. Section 01 33 01 - Submittal Procedures EPMS
2. Section 40 92 13.13 - Electric Channel Gate Actuators
3. Section 35 20 16 - Sluice Gates, Slide Gates & Channel Gates
4. Division 26 Electrical

## 1.3 QUALITY ASSURANCE

A. The UV manufacturer shall guarantee a minimum of 14,000 hours operating time for each lamp under the conditions specified herein and include on/off cycles at a maximum of 5 per 24 operating hours.

B. In case of premature lamp failure, the UV manufacturer shall offer the following:
   a. Lamp failure before 9,000 hours - send a replacement lamp free of charge
   b. Lamp failure after 9,000 hours – prorated up to 14,000 hours with credit issued toward the purchase of a new lamp.

C. The UV manufacturer shall ensure disposal of returned lamps (old/used) at no costs to the owner upon receipt of the returned lamps at the manufacturing headquarters. Shipping costs however shall be borne by the owner.

## 1.4 PERFORMANCE AND DESIGN REQUIREMENTS

A. The manufacturer of the UV disinfection system shall be responsible for the proper design of their system, including but not limited to UV modules, junction box, level control, and electrical control enclosures.

B. The system shall be capable of delivering a UV dose of 30 mJ/cm2, after 14,000 hours of lamp operation, at the peak flow rate, and a minimum UV transmittance of 65% at 253.7 nm.

C. The UV disinfection unit shall deliver the minimum UV inactivation dose at maximum flow capacity, minimum operating temperature, and the minimum design UV transmittance, with lamp output adjusted to account for the combined lamp degradation factor to simulate the end of lamp life condition. The end of lamp life shall be based on a lamp aging factor either determined from independent testing following NWRI guidelines and guaranteed by the UV supplier or the minimum of lamp aging factor of 80%. The minimum end of lamp life is of the nominal lamp output, which is defined as the full power amp output after 100 hour of lamp operation.

D. Dose calculation shall be in accordance with the point source summation method as described in the US EPA Design Manual (EPA/625/1-86-021) without exceptions.

E. The head loss through UV system (including level control) shall not exceed 9.0 inches at design flow condition.

F. The project conditions for the new system shall be as follows:

| | | |
|---|---|---|
| 1. | Peak Design Flow (Each Channel): | 4.2 MGD |
| 2. | Peak Design Flow (Two Channels): | 8.4 MGD |
| 3. | Average Flow: | 3.35 MGD |
| 4. | Total Suspended Solids: | < 30 mg/l |
| 5. | Particle Size Distribution | < 30 micron |
| 6. | 5-Day BOD | < 30 mg/l |
| 7. | Ultraviolet Transmittance@253.7 nm: | 65% |
| 8. | Water Temperature: | 35 deg. F to 85 deg. F |
| 9. | Ambient Air Temperature: | 30 deg. F to 86 deg. F |

10. Effluent Fecal Count < 200/100 ml (30 day geometric mean)

G. The theoretical retention time shall be 3.01 seconds at the design flow rate.

H. The cross section area occupied by the submerged part of the UV lamps module and frame at the entrance and exit of each bank shall not be greater than 35% of the cross sectional area of the wetted part of the effluent channel.

I. The ultraviolet disinfection system provided shall match the existing system in a parallel open channel and shall consist of two (2) banks with one (1) bank serving as a stand-by bank arranged in the following manner:

| | | |
|---|---|---|
| 1. | Total Number of Lamps: | 60 |
| 2. | Total Number of UV Modules: | 6 |
| 3. | Number of Lamps in Each UV Module: | 10 |
| 4. | Total Number of UV Banks: | 2 (1 duty, 1 standby) |
| 5. | Number of Enclosures: | One (1) Ballast Distribution Enclosure & 2 Ballast 72 Enclosures |

J. The total power consumption of the system shall not exceed the values given below at the design conditions:
1. 26.0 kW maximum installed
2. 15.0 kW at 4.2 MGD with one (1) duty bank in service

K. Channel dimensions shall be as follows:

| | | |
|---|---|---|
| 1. | Channel width: | 28 inches |
| 2. | Channel width at weir: | 72 inches |
| 3. | Channel total depth: | 38.78 inches |
| 4. | Channel water depth: | 23.22 inches |
| 5. | Channel length: | as noted on contract drawings |

L. The head loss through each channel with all restrictions factored in shall not exceed 9.0 inches at a flow of 4.2 MGD per channel. This head loss includes channel baffles, UV modules (incl. lamps and framework), effluent level control weir and any other equipment or restrictions, which may be required.

M. The lamp array configuration shall be a uniform array with all lamps parallel to each other and to the flow. The lamps shall have equal centerline spacing along the horizontal and vertical axes. The single array pattern shall be continuous and symmetrical throughout the UV system. Systems with a concentric array or staggered array and having an equivalent UV density shall have 30% additional lamps to compensate for the inefficiencies of these arrays as shown on Figure 7-33 of the US EPA Design Manual (EPA/625/1-86-021).

N. The system shall be designed for complete immersion in the effluent of the UV lamps within their protective quartz sleeve. Both electrodes and the full arc length of the lamp shall be below the water surface. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent. Systems designed whereby the lamps are inserted through a metallic bulkhead or which otherwise prevent uniform cooling of the lamp electrodes (e.g. vertical lamp systems) by the effluent shall not be permitted.

1.5 SUBMITTALS

A. The following documents shall be submitted for the UV system:
   1. Complete description in sufficient detail to permit an item comparison with the specification.
   2. Dimensions and installation requirements.
   3. Descriptive information including catalog cuts and manufacturers specifications for all components.
   4. Electrical schematics and layouts.
   5. Hydraulic calculations demonstrating compliance with the specified hydraulic characteristics.
   6. Dose calculations and results of tests performed by independent testing laboratory.
   7. Certification from the Lamp Manufacturer to substantiate lamp life warranty during continuous operation at 100% output. Certification shall be by a qualified independent 3rd party laboratory and shall be submitted to the ENGINEER to verify lamp output after 100 hours burn in. Measurements shall be taken through air at a distance of approximately 3 feet with a calibrated radiometer.

1.6 SERVICE CONDITIONS

   1. All components of the system shall be designed for continuous duty.

PART 2 PRODUCTS

2.1 GENERAL

A. All metal components in contact with the effluent shall be a minimum type 304 stainless steel. Aluminum wetted materials shall not be used.

B. All metal components located in or directly on top of the channel shall be constructed of 304L stainless steel.

C. All wiring exposed to UV light shall be Teflon coated or other suitable long term resistant materials.

D. All materials exposed to UV light shall be 316 stainless steel, quartz glass, Teflon, Viton, or other suitable long-term UV resistant materials.

2.2 UV LAMPS

A. Lamps shall be low-pressure mercury amalgam, high intensity type.

B. Lamps shall produce a minimum, new lamp (100 hours), output of 150 watts of UV-C energy at a wavelength of 253.7 nm (254 nm). Low pressure-low intensity of low pressure high intensity amalgam UV lamps with less than 150 watts UV-C output at 254 nm shall not be permitted due to increase in quantity of lamps required.

C. UV output energy of the lamps shall be variable. The lamp will be capable of maintaining a UV-C output proportional to the variable power settings from the ballast. Low pressure low

intensity or low pressure high output lamps with no capability to automatically vary the UV power output in operation shall not be permitted.

D. The UV manufacturer shall ensure disposal of returned lamps (old/used) at not costs to the owner upon receipt of the returned lamps at the manufacturing headquarters.

E. UV lamps shall not require a long cool down period prior to re-start should the power to the UV system fail or be interrupted for a short period of time. Systems of lamps that require long cooling periods, (e.g. 10 - 30 minutes) before re-start are not acceptable.

F. The lamp output shall not fluctuate more than 3% due to water temperature variations between 40-100 °F.

G. The operating skin temperature of the UV lamp shall not exceed 130°C in order to minimize the possibility of quartz fouling.

H. The lamp filaments shall be the clamped design, significantly rugged to withstand shock and vibration.

I. Each lamp base shall incorporate a dielectric barrier on pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions. The barrier shall be dielectrically tested for 2500 volts.

J. UV lamp maximum arc length shall be 56.3 inches.

K. Lamp basis shall be of a metal and ceramic construction resistant to UV and ozone.

L. The UV manufacturer shall provide certification of lamp output measured in Watts of UV output at a wavelength of 254 nm. An independent third party shall perform certification of lamp output.

## 2.3 UV LAMP ASSEMBLIES

A. Each UV lamp assembly shall consist of a UV lamp, enclosed in an individual quartz sleeve with the ends appropriately sealed using an O-ring sealed quartz end plug.

B. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.

C. The quartz sleeve shall be fixed to the module frame using stainless steel clips onto the end plugs of the sleeve. The quartz sleeve shall not come in contact with the stainless steel of the module frame.

D. The UV lamp sleeve shall be a single piece of clear fused quartz circular tubing open at both ends. It shall be rated for a minimum UV transmittance (254 nm) of 92%, which shall not be subject to degradation over the life of the system.

E. All electrical connections to the lamp assembly shall be made at one end through a four pin machined watertight plug connector.

F. The electrical connection end of the quartz sleeve shall be sealed by means of a protective retainer plug designed with dual O-rings to seal and hold the sleeves in parallel alignment. The retainers shall remain in place to protect the quartz sleeve ends against accidental damage, without impeding the removal and replacement of the UV lamp.

G. The lamp socket shall be centered against the inside of the quartz sleeve and shall be retained by a cup nut with ribbed exterior surface providing a positive handgrip for tightening / loosening without the need for any tools. This connection includes a self-contained o-ring, sealing the lamp and socket assembly (independently form the quartz sleeve).

H. The lamp assembly design and UV module mounting shall allow all of the following to be easily achieved by an operator for maintenance purposes:

I. Disconnection of lamp power cable only, without removing the UV lamp or the lamp assembly from the module.

J. Disconnection of lamp power cable and removal of the UV lamp without removing the lamp assembly from the module.

K. Disconnection of the lamp power cable and removal of the entire lamp assembly without removing the lamp from the assembly.

2.4 UV MODULES

A. Each UV module shall consist of a dual (side-by-side) row configuration of UV lamp assemblies, with three (3) modules of lamp assemblies in the vertical direction, giving a total of ten (10) lamp assemblies per module, 30 lamps per bank.

B. The module frame shall be constructed of heavy gauge, 316 stainless steel with stainless steel spring tension clips for holding the lamp assemblies in place. The top of the frame shall also serve as a UV reflector shield to prevent UV light from the exiting the UV bank area.

C. The end of the lamp sleeve shall not protrude beyond the stainless steel frame of the UV module.

D. The UV module shall be connected to NEMA 4 rated modular, quick disconnect plugs and sockets on the junction box, for ease of removal, by means of two or three separate sets of multi conductor cables, each covered by a flexible stainless steel conduit. The plugs shall connect the power cables to the lamps in the module, interlock and sensor cables, and wiping system airlines.

E. The UV modules shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves without requiring special tools.

F. Each UV module shall be equipped with an interlock switch, which will automatically disconnect power to its associated UV bank if the module is raised from the UV channel of the quick disconnect plug is removed.

G. The UV modules shall be designed for complete submergence without causing failures or damage to the system or components. They shall not contain any components, such as electronic cards, that cannot withstand complete submergence.

H. 316 stainless steel spacer/reflector panels shall be provided between the module reflectors so that no ultraviolet light is emitted from the channel when the UV modules are installed and the lamps are energized.

I. The UV module support frame shall be 316 stainless steel and be mounted in a position above the effluent level in the channel by means of slotted angles allowing precise adjustment of the module position within the channel during installation. Once correctly positioned, the frame will allow for permanent fixing to prevent any movement during the life of the installation. The frame shall be designed such that no fastening of the individual UV lamp modules is required other than a spring clip to overcome buoyancy of the module.

2.5 WIPING SYSTEM

A. Each UV module shall be equipped with an automatic wiping system with selectable wiping frequency and number of strokes. Systems without automatic mechanical wiping or removal of the module from the channel as the only means of cleaning will not be acceptable.

B. The automatic wiping system shall be pneumatically powered and shall use Teflon wipers to clean the quartz sleeves. Wiping frequency shall have an adjustable number of strokes and an adjustable timer interval.

C. The actuator for the wiping system shall be a pneumatic cylinder mounted to the underside of the module top plate. It shall not come in contact with the effluent to prevent damage, sealing challenges, replacement difficulties etc.

D. The total wiper holder assembly shall not shadow more than 0.75" of lamp length area at any time. Systems which shadow more than 0.75" of lamp length or arc at any given time shall have the lamp output watts de-rated by a proportional amount of wiper length to lamp arc length to account for the shadow or covering of the lamp by the wiper during operation.

E. The wiping system shall be PLC controlled and provide a fully automatic, unattended operation.

F. Wiping interval, the time between wiping cycles, shall be factory preset at optimum value based on water condition and shall be easily reset by the owner whenever actual conditions warrant. Interval range shall be typically 1 to 120 minutes. The number of wiping strokes per interval shall be factory preset for optimum effect and shall be easily reset by the owner from 2 to 5 strokes per interval. The useful life of the wiper brush or cleaning device in contact with the quartz sleeve shall be in excess of two years based on factory stroke and interval settings.

G. The cleaning system shall maintain uniform wiping tension and cleaning over complete wiping length of the quartz sleeve and the UV sensors. The cleaning system shall maintain full efficiency throughout its life, with no deterioration in quality of cleaning.

H. The wiper blade brush or other cleaning device in contact with the quartz sleeve shall be non-metallic and shall not damage or scratch the quartz sleeve or sensor in any way. To offset

cleaning mechanism wear and to maintain positive contact and wiping efficiency with the quartz sleeve, the wiper blade brush or other cleaning device shall be self-adjusting and shall automatically adjust to account for wear over it's useful life.

I. The wiped length of the quartz sleeve shall be no less than 56 inches or the complete arc length whichever is greater.

J. The wiping system airlines shall be quick connect type and shall not require the separate connection / disconnection of compression type fittings for installation or removal of the module from service. Each airline connector in the quick disconnect plug and socket shall have an integrated check valve so that upon removal of a module from service, system pressure is maintained.

K. The combined new and existing Xylem – Wedeco operation system shall utilize the existing self-contained air compressor package rated for 14.9 SCFM @ 90psig with a receiver tank, controls and air dryer.

## 2.6 UV MONITORING SYSTEM

A. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamp modules.

B. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm. It shall have sensitivity at 254 nm of greater than 95%. Sensors whose sensitivity to other wavelengths amounts to more than 5% of the total sensitivity shall not be allowed.

C. The UV intensity monitoring system shall be factory calibrated.

D. The measured intensity shall be displayed on the operator interface as an absolute value in $mW/cm^2$.

E. The UV sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and hence spurious false alarms for low intensity.

F. Systems without automatic cleaning of the intensity sensor shall not be acceptable.

## 2.7 WATER LEVEL CONTROL

A. A fixed weir plate shall be similar in design to the existing finger weir plate located at the channel outlet to provide control of level in the UV channel.

B. The dimensions of the weir shall be designed in accordance with the channel geometry and the peak hydraulic flow. Taking the disinfection requirements of the UV system and a maximum head loss restriction of 9.0 inches into account.

C. Weir assembly shall be suitable for end of channel or in channel mounting with a good seal to prevent low water level in the channel at low flow conditions.

2.8 LOW WATER LEVEL SENSOR

A. One (1) low water level sensor shall be provided for the new channel and shall operate independent of the existing channel level sensor in the operating channel.

B. During manual, automatic and remote modes of system operation, the water level sensor shall ensure that lamps extinguish automatically if water level in the channel drops below an acceptable level.

C. The low water level sensor shall be powered by the ICA (UV control enclosure).

2.9 MODULE LIFTING DEVICE

A. Two (2) davit cranes shall be provided to match the existing Thern Portable Davit Crane, Model 5110 crane alternate base socket for use in removing individual modules from the effluent channel.

B. The lifting devices shall be a crane with a hand winch and will include an adjustable boon with adequate reach and height for removal of the individual modules. A swivel handle shall be provided for rotation and positioning over the module.

2.10 ALUMINUM COVERS AND HOODS

A. Aluminum covers constructed of 0.125 aluminum checkered plate with ½" aluminum rod handles shall be provided to cover the UV junction box and lamp modules as shown on the drawings and to match existing covers fabricated by American Metal Fabricators, Gastonia, NC.

2.11 CHANNEL GATE ELECTRIC ACTUATORS

A. Two (2) electric channel gate actuators shall be provided in accordance with Section 40 92 13.13 of these specifications for installation by the Contractor on 28" x 30" yoke mounted channel gates.

B. The automated operation, power supply to the actuators and SCADA output shall be integrated into the control system for the UV system with power and control wiring installed by the Contractor. Automated operation of gates shall enable the opening and closing of the gates remotely.

2.12 ELECTRICAL

A. General
   1. The electrical system shall be designed to provide:
      a. Maximum reliability of the UV disinfection system.
      b. Segregation of plant services and supplies into sensible groups to allow for safe and simple maintenance or servicing whilst ensuring maximum possible disinfection capability is maintained.

2. Plug and socket quick disconnect facilities enabling non-technical personnel to carry out lamp replacement wiper insert replacement etc. without the need for any tools of special isolation procedures.
3. The location of sensitive electronic components, e.g. Electronic Ballasts, shall be chosen to ensure that a long service life can be guaranteed.
4. All heat sensitive components shall be adequately cooled with dry air utilizing forced or natural ventilation.
5. Systems or designs that subject sensitive electrical or electronic components to excess humidity or poor air quality for cooling are not acceptable.
6. Systems that lack positive mechanical heat transfer such as fans (or air conditioning) for sensitive electronic components are not acceptable.
7. Harmonic distortion correction equipment shall be provided by the UV manufacturers as required to meet IEEE519 of The Institute of Electrical and Electronic Engineers.
8. The enclosures for the UV system shall be NEMA 12 painted sheet steel with fans.
9. The major components of the UV electrical system shall be:
    a. System Control Enclosures, Power Distribution, and Electronic Ballast (SCE/PDE/EBE) Enclosure
    b. One (1) isolation transformer(s) either mounted inside the System Enclosure or provided separately in NEMA 3R enclosure adjacent to the enclosures
    c. One (1) double-sided junction box (JB)
10. Facilities for fully automated control and manual control independent of the PLC shall be provided.

B. System Control Enclosure (SCE)
1. The UV system SCE shall be utilized to control the UV channel equipment.

C. Power Distribution Enclosure (PDE)
1. Electrical power supply to the PDE(s) shall be 480 volts, 60 Hz, 3 phase, 4 wire connection (delta).
2. The PDE shall provide a single point of isolation for a complete UV channel.
3. The PDE shall provide the individual power supplies, with appropriate circuit protection levels, required for the operation of a single channel including, each bank EBE and auxiliary electrical plant associated with the channel.

D. Transformer
1. The transformer shall provide the required voltage of 400 V, 3 phase, to the EBE(s).
2. Electrical power supply to the transformer shall be 480 volts, 60 Hz, 3 phase 4 wire connection.
3. The location of the transformer(s) shall be either within the PDE(s) or in their own NEMA 3R enclosure adjacent to the enclosures.

E. Electronic Ballast Enclosure (EBE)
1. The EBE shall be a single or single multi door enclosure, which shall house all the control gear, and electronic ballasts etc. associated with a single bank of UV lamps.
2. The EBE shall have a door interlocked isolator, which shall be the single point of isolation for the full bank of lamps, enabling simple isolation for safe working on the lamps etc. The door-interlocked isolator shall provide the facility to lock the system off with padlock.
3. Each EBE shall be equipped with a temperature control device, which will shut off this part of the UV system in case of surpassing the critical limit of 50ºC = 122 ºF.

4. UV systems, which do not have a temperature control device to protect the ballast life and prevent pre-mature aging and failure, shall not be acceptable.
5. Each EBE shall be equipped with a cabinet heater to prevent the formation of moisture due to humidity.
6. UV systems, which do not provide the protection of ballasts from moisture with a heater, shall not be acceptable - even if the ballasts are theoretically completely sealed from the environment.

F. Junction Box (JB)
1. The JB shall be a stainless steel unit (stainless steel 304), which spans over the channel and provides all service connections for the associated bank of lamps, sensor, position and safety switches, wiper system operation etc. via quick disconnect plug and socket arrangements.
2. The JB shall provide individual termination points for all field cabling and airlines entering the unit.
3. The quick disconnect plug and socket arrangement will be on one side or two sides of the JB.
4. Access to the field terminations inside the JB shall be via a bolted door with weatherproof seal.
5. The construction of the JB shall provide mechanical protection for all cabling and airlines entering the JB.

G. Electronic Ballast
1. The ballasts shall be electronic microprocessor controlled, designed as slot in cards fitting into a rack system with a plug connector for ease of maintenance.
2. Each ballast shall drive a pair of lamps with independent control and monitoring circuits, and providing individual lamp status information to the PLC.
3. The ballast shall produce a volt free lamp power supply operating at above supply frequency and optimized to preserve lamp life.
4. The ballast shall detect lamp failure and initiate a re-strike sequence, independently from any external influence. The ballast shall attempt three re-starts before shutting off.
5. The ballast shall incorporate a galvanic separation of the two circuits. In case of the secondary circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned. Ballast without this feature shall be equipped with one GFC per ballast.
6. The ballast shall incorporate a filament pre-heat circuit to minimize lamp failure on start-up.
7. The operating power factor for the ballast shall be above 0.98.
8. The ballast shall be capable of varying the lamp power between 50-100% proportional to 4-20 mA control signal.
9. The configuration of ballast cooling shall include a minimum of two independent forced ventilation systems, to reduce risk of ballast overheating in the event of a single ventilation failure.
10. Ballast systems, which rely on natural ventilation, or a single forced ventilation system shall not be permitted.
11. Ballast requiring liquid closed loop re-circulating heat exchanger systems, e.g. propylene glycol, for cooling shall not be permitted.
12. Ballasts, for which replacement a watertight seal needs to be broken, shall not be permitted.

13. Ballasts for which replacement the removal of the module is required, shall not be permitted.

H. Control and Instrumentation
   1. All instrumentation used in the UV disinfection system control or monitoring shall be individually fuse or circuits breaker protected to minimize the effects of any single point of failure. All instrumentation shall be designed for use in the application for which the UV system is using it.
   2. All instrumentation shall be installed as per manufacturer instructions.
   3. All instrumentation used for online process measurement shall be located in the medium it is measuring and not rely on transfer of medium external reservoirs or chambers where changes in characteristics being measured could occur.
   4. This shall apply specifically to Transmittance measurement of effluent and shall prelude any straining or filtering which would clearly affect the characteristics of the medium being measured.
   5. A UV Disinfection Management System shall control the On/Off cycling and lamp power of the UV banks based upon a Dose pacing philosophy.
   6. The Management System shall utilize a UV sensor located within the UV banks(s) to accurately sense any change in lamp power, effluent transmittance and compensate for any reduction in the UV-C output due to lamp aging.
   7. The UV Disinfection Management System shall receive inputs from the UV sensor and flow meter and shall automatically adjust the received UV dose to maintain the required levels under all operation conditions. Systems, which actively monitor only flow and use independent transmittance for theoretical Dose paced control, are not adequate or acceptable.
   8. The UV Management System control shall include a dose pacing.
   9. The controls for the new UV-3 and UV-4 equipment shall be integrated with the existing UV-1 and UV-2 equipment for coordinated operation of all four (4) channels.

I. SCADA System Output
   1. The existing plant UV system has been modified to eliminate hardwired monitoring of the UV system via SCADA. Those modifications include the addition of a Modbus TCP communications link between the UV system and SCADA RTU3. This Modbus TCP communications link will accommodate monitoring of the new UV channel equipment to be installed as part of this project. The UV vendor shall provide I/O mapping information for coordination with the SCADA integrator to accommodate SCADA monitoring of the UV system status.
      a. The intent is for monitoring of the new UV system to match that of the existing UV system. Details shall be coordinated and verified with the Owner's plant staff.
      b. In addition to matching existing UV system monitoring, Open/Closed Position of Channel Gates for each UV system shall be monitored.
      c. It is anticipated that up to 60 discrete tags in the new UV system will be monitored by SCADA.
      d. It is anticipated that up to 20 real tags in the new UV system will be monitored by SCADA.

J. Spare Parts and Safety Equipment

1. The following spare parts shall be provided as a minimum:
    a. Two (2) boxes of replacements ballast (6 ballasts/box)
    b. Two (2) boxes of control cabinet filter replacements.

PART 3 EXECUTION

3.1 All plant and equipment must be installed shown on the contract drawings and in accordance with manufacturer instructions and approved drawings.

3.2 The UV manufacturer shall provide full submittal drawings and documentation to include:

A. Written documentation of preliminary wastewater testing performed to verify transmittance and design requirements.

B. Statement of the power consumption per lamp (including ballast loss) and the system peak power consumption (including ballast loss), for both new lamps and the end of lamp life.

C. Statement of head loss through the channel with all restrictions, weirs and flow controls factored with all system components that contribute to head loss shall be itemized. This shall be done for the design, average, minimum and maximum daily hydraulic flows.

D. An employee of the manufacturer shall commission the UV equipment.

3.3 The manufacturer shall furnish instruction and assistance necessary for proper installation and operation of the equipment. After installation, a start-up technician shall inspect the complete installation, place the equipment into permanent operation, instruct the OWNERS's personnel in operation and maintenance and perform field tests to insure proper installation. A minimum of one (1), 8 hour days at the job site excluding travel shall be included for this service. All startup and training services shall be exclusive of time included on current warranty services with existing equipment.

3.4 Final acceptance testing shall require satisfactory achievement of the specified final effluent Fecal Coliform count of < 200 per 100 ml for a minimum period of seven (7) consecutive days.

3.5 After installation and final testing, the manufacturer shall certify to the OWNER/ENGINEER that all equipment is properly installed, and that the plant operators have been instructed on proper operation and maintenance procedures. Local manufacturer's representatives are not acceptable to perform these tasks.

PART 4 WARRANTIES

4.1 The UV equipment furnished under this section (excluding consumables such as UV lamps and wiper rings) shall be warranted to be free of defects in material and workmanship including damages that incurred during shipping for a period of one (1) year from start-up or 18 months after shipment, whichever occurs first. The severity of the defect will determine the requirement of a site visit. All travel expenses accommodations etc. for a service visit due to a defect deemed severe by the manufacturer shall be included in the warranty. Travel expenses for procedures classified as routine maintenance (i.e. lamp, sleeve, ballasts and sensor replacement) are not included under this warranty.

4.2 The manufacturer shall guarantee 14,000 hours operating time for each lamp under normal operating conditions. Normal operating conditions include:

A. On/off cycles max. 5 per 24 operating hours,

B. Voltage fluctuations (230/400 V ± 10% relating to 480 V ± 10%).

END OF SECTION

SECTION 43 41 16.16
VERTICAL FIBERGLASS STORAGE TANK AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. The contractor shall furnish all labor, materials, equipment, supplies, fittings and appurtenances required for the fabrication, installation and startup of a fiberglass-reinforced plastic (FRP) above ground tank and accessories for the storage of liquid Polyaluminum Chloride (PAC) (or aluminum sulfate) as shown on the plans and specified herein.
   1. General
      a. The items indicated under this specification shall be furnished by manufacturers having experience in the manufacture of similar products and having a record of successful installations. Fabricators shall be accredited under the guideline of ASME RTP-1 as a minimum standard of quality accreditation.
      b. All fiberglass items shall be manufactured of material suitable for the service and shall be certified for such use on the shop drawings. Tanks shall be designed and checked for all loads to be incurred during shipment, service, including, but not limited to wind and temperature stress.

1.2 Related Work

A. See the following sections specifications for related work:
   1. Section 01 33 01 – Submittals EPMS

1.3 SUBMITTALS

A. Submit tank layout drawings showing dimensions, wall thickness, knuckle radii, nozzle and manhole location, dimensions and orientation, resin, surfacing veil, laminate sequences, and nozzle construction.

B. Submit installation instructions for installing tank on a concrete slab.

C. Submit tank manufacturer's recommended bolt torque for flanges.

D. Submit design calculations for structural design of walls and design of tie-down lugs.

E. Submit manufacturer's certification that tank construction complies with ASME RTP-1 or ASME RTP-1 Stamp.

F. Nozzle schedule including size, mark, thickness, and rating.

G. Details of all clips and lugs for hold down lugs, pipe brackets, and anchor bolts, as integral parts of the tank.

1.4 INDUSTRY STANDARDS

A. The tank shall meet the requirements of ASME RTP-1, PS 15-69, ASTM D-3299-88, and or ASTM D-4097-88 for Reinforced Thermoset Plastic Corrosion Equipment.

B. Tanks designed or fabricated in accordance with ASME RTP-1 shall be designed and fabricated by an accredited shop with a current certificate issued by ASME. The Manufacturer shall submit a current copy of the Certificate of Accreditation Issued by ASME for RTP-1 to be acceptable.

C. The tank shall be furnished complete, including all accessories as shown on the drawings.

1.5 NAMEPLATES

A. The tank shall have a resin coated nameplate installed on the tank and shall have the following information printed on the nameplate:
   1. Name of Customer
   2. Capacity in Gallons
   3. Chemical Environment
   4. Manufacturer Serial Number
   5. Year Built
   6. Name and Equipment Number
   7. Purchase Order Number
   8. Maximum Specific Gravity
   9. Design Pressure and Temperature
   10. Resin and laminate construction
   11. Manufacturers file number

1.6 BASIS OF DESIGN

A. Tank Dimensions – 10-foot I.D. x 14' straight shell height

B. Capacity - 8,000 gallons

C. Tank Design - Vertical, cylindrical with flat bottom and domed top.

D. Contents -Polyaluminum Chloride (PAC) with a pH of 3.5 and specific gravity of 1.2 at ambient temperature.

E. Operating Conditions - Atmospheric pressure and ambient temperature

F. Loading: Via delivery truck.
   1. Seismic - Zone Group I; Soil Site Class B; Ss = 0.348; S1 = 0.104; Importance Factor = 1.5
   2. Wind - Velocity = 90 mph; Structure Class = I; Exposure = C; Round Tank Wind Pressure = 6.2 psf
   3. Snow - 10 psf

G. Nozzles and fittings - As shown on plans

H. Insulation and Heat Tracing as specified herein.

PART 2 PRODUCTS

2.1 RESIN

A. The resin and all material shall conform to that specified in the FRP data sheet. The same resin shall be used throughout the laminate unless otherwise specified.

B. Resin shall be a premium grade vinyl ester such as Derakane 411 or equal with a 100 mil corrosion barrier.

C. The cure system used for the resin shall be in accordance with the resin manufacturer's current recommendations.

D. Proper curing of the resin is the fabricator's responsibility. All products fabricated to this specification shall be cured to at least 90% of the minimum Barcol hardness specified by the resin manufacturer. (Note: The use of paraffin in the resin or the use of a polyester veil may lower the Barcol hardness below the resin manufacturer's specifications.)

E. A separately cured gelcoat shall not be used unless specified by the owner.

F. No chemical-resistant surface shall be acetone sensitive.

2.2 REINFORCEMENT

A. Unless otherwise noted on the drawings or data sheet, surfacing veil shall be "C" glass.

B. Chopped strand mat shall be Type E (an electrical borosilicate) glass, 1 ½ oz or 2 oz. per square ft., with silane finish and a styrene-soluble reactive binder.

C. Continuous roving used in a chopper gun for spray-up shall be Type E glass.

D. Woven roving shall be Type E glass, nominal 24 oz./sq. yd., 4 x 5 weave, with silane-type finish.

E. Continuous roving used for filament winding shall be Type E glass with a silane-type finish.

2.3 DESIGN

A. General: It is the object of this Engineering Specification and associated drawings to afford the fabricator as much design latitude as possible. Therefore, it is intended that the fabricator will have ample opportunity to utilize his particular "know-how" in the design and details of tank fabrication in order to produce equipment that will be adequate for the intended purpose and at a minimum cost.

B. Design of Details: Fabricator to submit design calculations stamped by a Professional Engineer.

C. Design Basis / Safety Factors

D. Safety Factors for internal and external pressures shall be 10:1.

E. Safety Factors for seismic and wind loads shall be 5:1.

F. The tank shall be provided complete with all required pipe and instrument nozzles, manways, access ladder and cage, overflow with piping extending to tank base and fill piping as shown on the drawings.

2.4 FABRICATION REQUIREMENTS

A. The fabricator shall not sublet any FRP component assembly without obtaining the owner's approval in writing.

B. Hand lay-up per NBS PS 15-69, Contact Molded per ASTM D 4097-01, Filament Wound per ASTM D 3299-10 and per ASME RTP-1 Design Only, No Stamp/Certification, Sections 3 &4 Only, Level II Non-Critical Service.

2.5 SHELL AND HEAD REQUIREMENTS

A. The minimum wall thickness shall be ¼" regardless of operating conditions.

B. Unless otherwise specified, all vertical tanks shall be of flat-bottomed construction, continuously supported on a flat concrete pad, or equivalent.

C. The knuckle radius of all flat-bottomed tanks shall be 1 ½" minimum.

2.6 LAMINATE REQUIREMENT

A. The outer surface of the fabricated product shall be smooth with no glass fibers exposed. On custom contact molded equipment, the final ply shall be mat or spray-up.

B. The completed tank is to have a pigmented gel coat containing UV inhibitors applied to the exterior surface. Color to be specified by the owner.

C. All edges of reinforcement material shall be lapped: 1" minimum for mat, and 2" minimum for woven roving. Lapped edges of adjacent layers shall be staggered.

D. On laminates containing woven roving, cut edges exposed to the chemical environment shall be coated with resin and surfacing mat, and all other cut edges may be coated with resin only. The resin used shall be designated in the purchase specification and must contain paraffin to assure adequate surface cure.

2.7 HEAT TRACING AND INSULATION

A. Fiberglass mesh type heat tracing, specifically designed for fiberglass tank applications, shall be secured to the lower one-third of the tank shell prior to application of insulation. The heat tracing shall be wired to a temperature controller, mounted in a NEMA 4X fiberglass enclosure with junction terminals block affixed to the tank sidewall.

B. The tank heating system shall be suitable for maintaining tank contents at 60-degree F with ambient temperature at 20-degree F. A maximum of 800 watts shall be required to maintain specified temperature.

C. Rigid foam insulation, in sheet form, shall be secured to the tank shell and top dome following application of heat tracing. Insulation shall be 2" thickness, with normal density of 1.9 lbs/cf and U-Factor less than 0.1 BTU/Hr/sq. ft./degree F.

D. An exterior 100 mil thickness fiberglass protective laminate shall be applied. This laminate shall be made up of isophthalic polyester resin, reinforced with chopped glass fiber and compounded with ultraviolet inhibitor. A minimum of 5 mil thickness polyester gel coat outer finish shall be applied in color selected by Owner from manufacturers standard color chart. An expansion joint shall be included, filled with elastomeric caulk seal, to preclude temperature differential stresses on the outer laminate.

## 2.8 EQUIPMENT AND TANK CONNECTIONS

A. Unless otherwise specified, all connections on equipment and tanks shall be flanged.

B. Manways on storage tanks and equipment shall be 24" I.D. minimum.

C. All flanges shall be made by the hand lay-up construction. Press molded flanges are not acceptable. Flange shall be manufactured of one-piece construction with integral stub.

D. The machine facing of the back of hand lay-up flanges is not permitted. All bolt holes shall be spot faced for SAE size washers if required.

E. Flange drilling on pipe connections shall be in accordance with ANSI B-16.5 for 150 lb.

F. All nozzles 4" diameter or less shall be reinforced with plate or conical gussets.

G. Bolt holes in flanged nozzles are to straddle the vertical centerline.

H. On all flanged joints, use 1/8" thick full-faced neoprene gaskets having a specified Shore A Durometer hardness. Supplied by others, unless otherwise specified on data sheets.

I. Reinforcement of nozzle and manhole openings in vessel walls shall be in accordance with the requirements of ASME RTP-1. The reinforcement pad shall consist of alternate piles of mat and woven roving. The edges of all reinforcing overlays shall be tapered to avoid abrupt change in overall thickness of vessel laminates.

## 2.9 ACCESSORIES

A. The tank shall be fitted with the following accessories.
   1. One (1) - 24" size top manway, gasketed with bolted cover.
   2. One (1) - 3" flanged spare nozzle side connection.
   3. One (1) - 2" flanged top inlet connection for recirculation return.
   4. One (1) - 2" top inlet connection and associated piping for filling tank from truck delivery.
   5. One (1) - 2" flanged bottom drain.

6. One (1) - 3" gooseneck vent on top with FRP vent piping extending to 2-foot above bottom of tank.
7. One (1) - 6" flanged connection for ultrasonic level sensor.
8. One (1) aluminum access ladder and platform assembly with safety cage for external access to the tank manway, matched to ladder and platform mounting brackets integrally laminated to the primary tank shell.
9. One (1) - aluminum access ladder to secondary containment area complete with mounting lugs, safety cage and walkway from top of ladder to center manway.
10. Six (6) - hold-down clips and stainless steel anchor bolts.

## PART 3 EXECUTION

### 3.1 CLEANING

A. Prior to inspection, all dirt and extraneous materials shall be removed from the equipment interior. The fabricator shall remove all surface markings, coatings, or contaminants prior to inspection.

### 3.2 SHIPPING

A. Whenever feasible, shipments shall be made by truck.

B. Tanks that are shipped in horizontal position, with tank end blocking used to prevent shifting, must be padded and bare only upon the knuckle radius of the tank bottom.

C. Tanks shall be secured to the trailer, cradles or skids to prevent rotation or other movement.

D. Flange faces shall be protected from damage by covering with suitable plywood or hardboard, securely fastened. Note: Tanks shall be positively vented at all times.

### 3.3 INSTALLATION

A. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings.

### 3.4 WARRANTY

A. The tank manufacturer shall provide a minimum one-year warranty from start-up or 18 months from shipment whichever comes sooner.

END OF SECTION

SECTION 44 42 39
PRELIMINARY TREATMENT EQUIPMENT

## PART 1 GENERAL

### 1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete and satisfactory operation of a 3-plane cylindrical bar screen, vortex grit removal system, grit classifier and blowers for the removal of floating, particulate, fibrous and grit materials from wastewater as shown on the drawing and described in these specifications.

B. RELATED REQUIREMENTS:
   1. Section 01 33 01 – Submittals EPMS
   2. Section 01 43 13 - References
   3. Division 26 - Electrical

### 1.2 SUBMITTALS

A. Section 01 33 01 - Submittal Procedures EPMS specifies requirements for submittals.

B. Drawings shall be submitted to the ENGINEER for approval and shall include:
   1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories and clearances required.
   2. Certified factory operational test and characteristic curves showing field performance for each pump.
   3. Wiring and schematic diagrams including accessories.
   4. Recommended spare parts list.
   5. Operation & maintenance manual

### 1.3 SYSTEM DESCRIPTION

A. The 3-plane cylindrical bar screen system shall consist of a stationary screen basket, rotating rake arm, concentric conveyor/dewatering screw, integral screenings press with drive unit, pivoting support stand, liquid level sensing system and weather protection system.

B. The vortex grit collection equipment shall consist of a drive assembly with paddles, grit airlift pump, grit fluidizer, duplex blowers and grit classifier with weather protection system.

C. The basis of design and required performance requirements for the cylindrical bar screen and grit removal system shall be as follows:
   - Number of 3-Plane Cylindrical Bar Screens 1
   - Number of Vortex Grit Systems 1
   - Number of Blowers 2
   - Influent flow (from pump station), mgd 4.2

- Maximum hydraulic capacity, mgd 8.4
- Maximum Screen Upstream Liquid Level, inches 29.5
- Maximum Screen Clean Water Headloss, inches 16
- Grit Chamber Inside Diameter, feet 12

1.4 PRE-QUALIFICATION

A. Equipment manufacturers not listed as acceptable shall submit the below listed information specific to their system in accordance with EJCDC® C-200 - Instructions to Bidders.
   1. Certification that drive speed reducer manufacturer is a member of AGMA and that the torque and thrust ratings are in accordance with AGMA standards.
   2. Certification that the specified machining noted for mating surfaces is part of the manufacturing process.
   3. Screen hydraulic performance curves showing the relationship of headloss versus the full range of downstream liquid depths for the maximum hydraulic capacity. Curves based upon other manufacturer's data will note be acceptable for this project.
   4. Data from three (3) separate tests proving compliance of the screen with the "Paint Filter Test" as described in EPA Publication SW-486 Method 9095

1.5 PERFORMANCE

A. The cylindrical bar screen system shall meet the following minimum performance requirements:
   1. The 3-plane cylindrical bar screen shall be designed to handle the maximum hydraulic capacity with the maximum upstream liquid level depth including the maximum allowable clean water headloss.
   2. The nominal bar spacing shall be the clear opening between the fixed bar elements only. Screen designs that define the bar spacing as the distance between a fixed bar element and a moving adjacent rake element (step-type screen) will not be acceptable for this project. Screens using perforated plate, traveling filter media, wedge wire or fabric wire will not be acceptable for this project.
   3. The average bar screen flow through velocity shall not exceed 3.3 ft/sec (1.0 m/sec) under any flow condition up to the maximum hydraulic capacity. The screen design shall minimize solids deposition in the channel.
   4. The 3-plane cylindrical bar screen shall be rotary raked, cylindrical bar screen with an integral screw conveyor and press. The 3-plane cylindrical bar screen shall use a single drive for screening, conveying, dewatering and compressing screening material.
   5. The operation of the rake cleaning mechanism shall be automatically initiated at a preset high liquid level. Screens that operate continuously or via timer only will not be acceptable. The rake shall remove solids from the screenings basket and deposit them into the concentric screw conveyor though after passing through a cleaning comb, where reverse movement of the rake shall provide positive cleaning of the rake mechanism. The screenings shall be transported up the screw conveyor and through a compression chamber.
   6. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint filter Test as described in method 9095 of EPA Publication SW-486.
   7. Due to potential high solids loadings in wastewater, the entire screen basket shall be completely cleaned in no more than a maximum allowable cleaning cycle time of 11 seconds to ensure minimum headloss and rapid cleaning of the screen. All open spaces of the screen

shall be positively cleaned via teeth that pass through the full depth of the bars during each cleaning cycle. Spray wash water or screw flights with brushes will not be an acceptable method of cleaning the screen.

8. The control system shall be designed so that the cleaning characteristics of the screen and spray wash systems can be changed via the programmable controller.
9. Each screen shall be furnished with a dual screenings spray wash system to flush organic material from the screenings prior to compaction and dewatering. The dual screenings washing systems shall be designed to minimize the amount of organic material in the screenings and to maximize solids dryness after compaction and dewatering. The dual screenings washing systems shall include:
    a. Lower wash system shall be located immediately prior to the point where the screenings are removed from the screen and enter the screenings transport tube. This wash system shall pre-wash the screenings to remove fecal material and to prevent material from sticking to the screw conveyor flights.
    b. Screenings wash system shall be located just prior to the beginning of the compaction zone after maximum maceration of the screenings by the screenings transport screw conveyor. At the maximum wash water flow rate of 30 gpm, the screw conveyor shall be designed to prevent screenings from being washed down the screenings transport tube to the basket.
    c. To minimize odors and nuisance insect populations, the 3-plane cylindrical bar screen transport system and compaction/dewatering system shall be completely enclosed.
    d. The spray wash systems shall be completely enclosed to prevent spray, aerosols, and leakage from coming in contact with the operating floor.

B. The grit removal system shall be engineered to meet the following requirements at up to the maximum design hydraulic capacity:
    1. Remove 95% of grit greater than 50-mesh in size.
    2. Remove 85% of grit greater than 70-mesh in size.
    3. Remove 65% of grit greater than 100-mesh in size.

    The efficiency level relates to grit having a specific gravity of 2.65 and to the difference in grit content in the influent channel as compared to that of the effluent in the effluent channel.

C. The grit classifier shall be designed to receive a maximum up to 190 gallons per minute of grit slurry flow from the vortex grit removal system and to convey up to 30 cubic feet per hour of dewatered grit.

## 1.6 MATERIAL QUALITY

A. All fabricated components of the 3-plane cylindrical bar screen shall be AISI Type 304 stainless steel including the screen basket, screw conveyor, outer screen housing and support structure. All fabricated components of the grit chamber and grit classifier shall be AISI Type 304 stainless steel.

B. All fabricated components shall be manufactured in the United States. To ensure prompt service and to ensure spare parts availability in a timely manner and at a reasonable cost, stocking distributors must be located within the continental United States.

## 1.7 QUALITY ASSURANCE

A. In order to assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these specifications that all equipment called for under this section shall be supplied by a single manufacturer. The equipment manufacturer shall, in addition to the CONTRACTOR, assume the responsibility for proper installation and functioning of the equipment.

B. Naming an acceptable manufacturer does not preclude the compliance with the performance and salient features. The contract documents represent the minimum acceptable standards for the screening and grit removal equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. Equipment that is a "standard product" with the manufacturer shall be modified, redesigned form the standard mode, and shall be furnished with special features, accessories, materials of construction or finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.

# PART 2 PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURERS

A. The Cylindrical Bar Screen equipment shall be manufactured by Lakeside Equipment Corporation of Bartlett, IL; Huber Technology of Huntersville, NC; Smith & Loveless of Lenexa, KS or approved equal.

## 2.2 3 PLANE CYLINDRICAL BAR SCREEN (RBS-101)

A. Screen
   1. The 3-plane cylindrical bar screen shall be designed and built to withstand maximum possible static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during the screening, conveying and pressing operations. All submerged component and all components of the 3-plane cylindrical bar screen in contact with the screened solids shall be of stainless steel constructions.
   2. The screen basket shall be of a cylindrical shape that shall be open at the top. The screen bars shall be perpendicular to the centerline of the screen. The basket ring support bars shall have adequately machined slots so that the rake teeth can penetrate the basket ring bars to ensure proper cleaning of the full basket depth.
   3. The screen basket shall use graduated depth bars to provide three (3) distinct screening plans (bar heights) on the screen interior to provide superior solids capture and removal from the flow. Designs that utilize a single bar height will not be acceptable for this project. The nominal bar spacing shall be ¼ inch. Perforated plate, fabric wire, wedge wire or lamella plates will not be acceptable screen media.
   4. Each ring shall be fabricated from sections that have been cut from flat cold rolled stainless steel sheet to minimize warping of the rings. Basket ring designs manufactured from rolled bar stock into rings will not be acceptable for this project. Each basket ring section shall be provided with an integral strengthening gusset at each attachment point to the support bars for added basket strength. The stainless steel support bars shall be machined with slots to

provide the proper bar spacing. Each basket ring shall be inserted into the machined slot of the basket support bars and when welded to the support bars to provide a superior strength basket design.

5. The main screen basket upper support ring shall be a minimum of 5/8-inch thick and shall be machined to match the transport tub main support flange to ensure proper alignment of the basket and the rotating rake arm to provide a run out of not more than 0.005 inches with a concentricity to within 0.005 inches. The main screen basket lower support ring shall be 7/8-inch minimum thickness.
6. The minimum diameter of the screening basket shall be 55 inches. The basket diameter shall be matched with a sufficient number of bar spacing to ensure the maximum hydraulic capacity flow rate noted in the Basis of Design, is achieved and to provide less than 16 inches maximum headloss.
7. The width of the screening channel shall be as shown on the drawings.
8. Side seal plates shall be provided to enclose the circular screen and the rectangular concrete channel. Side seal plates shall be two-piece fabricated of 10 gauge minimum stainless steel and shall be of sufficient height to percent bypassing of flow around the screen at the maximum hydraulic capacity flow rate.
9. The screen shall be provided with a pivoting support stand allowing for easy removal of the screen basket from the channel for maintenance purposes. To ensure operator safety during servicing of the screen, supports and support stand shall be fabricated from ¼-inch minimum stainless-steel shapes and plates.
10. A set of stainless steel lower screen basket support brackets fabricated of ¼-inch sections shall be provided to support the basket in the channel. Support brackets shall allow vertical adjustment of the screen basket so that it does not rest on the channel floor.

B. Rotating Rake and Cleaning Comb

1. The rotating rake assembly shall penetrate the depth of the bar screen to ensure positive solids removal. Rake shall be cast stainless steel or water-jet cut stainless steel for superior life. Designs using a fabricated rake head or that use a screw conveyor with a brush to clean the screen will not be acceptable for this project. Rake tooth root design shall match the 3-plane design of the basket rings to ensure proper cleaning of the screen bars.
2. The rake shall reverse at least once during the cleaning cycle to pass through the topmost position where it shall be cleaned by a cast stainless steel or water-jet cut stainless steel hinged cleaning comb installed at the top of the screen basket. The cleaning comb shall be designed to match the rake profile to ensure cleaning of the spaces to the root of each tooth in the 3-plane rake design. Cleaning comb shall be supported at both ends by a nylon bearing and shall pivot and return to the standby position without the use of counterweights.
3. The rotating rake and the screw conveyor shall be fixed to the same shaft and driven by a common drive.
4. A stainless steel backed nylon brush shall be attached to the rake arm and positioned to make contact with the screening trough to sweep material caught on the edges of the trough.

C. Screenings Conveyor and Screenings Dewatering Press

1. The screenings screw conveyor transport tube nominal diameter shall be 14 inches with a minimum Schedule 10S wall thickness. A minimum of three (3) anti rotation bars with ¼-inch minimum thickness shall be welded to the inside of the transport tube along the longitudinal axis from the compaction zone to the beginning of the screenings collection

trough. The screenings screw conveyor shall not depend on support from the anti-rotation bars during normal operation.

2. A basket support plate flange shall be a minimum of ¾-inch and shall be welded to the lower end of the screenings transport tube to attach the screen basket and to provide for attachment of the screenings collection hopper. A ½-inch minimum thick drive support flange shall be welded to the upper end of the screenings transport tube for attachment of the drive assembly. After all welding of components to the screenings transport tube have been completed the fabrication shall be placed in a lathe to machine the face of the upper drive flange, to machine the face of the lower basket support plate flange for mating the basket and to machine the lower bearing housing. A ½-inch thick minimum drive assembly adaptor stainless steel flange shall be provided to bolt to the upper drive support flange.
3. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be all AISI Type 304 stainless steel construction with a minimum thickness of 3/16-inch with increased 3/8-inch thick minimum thickness in the screenings collection trough and in the compaction and dewatering zone. Designs using a shaftless screw design shall be fabricated of AISI Type 316Ti stainless steel to minimize stress relief after fabrication and shipping. Flight pitch distance shall be a maximum in the screenings collection hopper and shall be reduced along the length of the screenings transport tube to a minimum pitch distance in the compaction zone. Constant pitch screenings screw conveyor designs will not be acceptable for this project.
4. The upper and lower screenings conveyor torque tube shall be fitted with a solid stainless-steel stub shaft. The shafts and screenings screw conveyor torque tube shall be accurately machined to allow a bolted shrink-fit design. The upper screenings conveyor torque tube shall be fitted with a removable stainless-steel stub shaft that may be changed for adapting to speed reducers that are produced by various manufacturers. Welding the upper and lower stub shafts to the screening transport screw conveyor torque tube will not be acceptable for this project.
5. The lower end of the screenings conveyor shall be supported by a sealed, water-flushed, self-lubricated lower polymeric composite sleeve bearing with stainless steel wear sleeve. Metallic-based lower bearings will not be acceptable for this project. The lower bearing shall not take any thrust load from the screw conveyor. Flush water shall be furnished with a stainless-steel water feed line connected to the lower bearing housing to maintain a positive pressure in the bearing cavity, which will reduce potential bearing contamination. A minimum of two seals shall be provided each with a UHMW polyethylene seal retainer plate. The stainless-steel bearing housing shall be field replaceable and shall be machined to mate with the screenings collection housing by a bolted connection. Designs in which the bearing housing is welded directly to the screen body will not be acceptable for this project.
6. Rake arm attachment hub outer diameter shall match the outer diameter of the stationary bearing housing to minimize material wrapping around the shaft. A seal plate shall be furnished to mate between the stationary lower bearing support and the rotating arm to prevent material intrusion into the bearing seals. The rake arm attachment hub shall be split to provide compression fit. The use of keys with keyways or a direct bolted connection to attach the rake arm to the screenings screw conveyor lower stub shaft will not be acceptable for this project.
7. Drainage holes shall be provided along the entire length of the screenings collection trough invert to allow for gravity drainage of wash water without flushing screenings out of the trough. Drainage hole diameter shall be smaller than the bar spacing. The width of the

drainage section shall be based upon a minimum 65-degree arc. The drainage section perforated plate material shall be fabricated from 11 gauge minimum thick stainless steel and shall have a minimum 50% open area for free water drainage.

8. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the wastewater channel through circular holes that are machined into the screenings transport tube. Compaction zone shall be fabricated from 12 gauge minimum thick stainless steel welded to the screenings transport tube to provide a watertight screenings pressate collection chamber. Compaction zone housings that are non-metallic and which require seals to prevent leakage around the screenings transport tube will not be acceptable for this project. Compaction zone housing shall be furnished with a hinged and gasketed access cover held in place with stainless steel latches as well as a removable dewatering section panel inside the dewatering chamber to allow direct access to the screw conveyor should the compaction zone ever become plugged. Designs that require removal of the drive assembly, discharge head or screw conveyor to gain access to the compaction zone will not be acceptable for this project.
9. Water that is released from the screenings shall be returned via a reinforced rubber hose attached to the dewatering section. Drain design shall allow for removal and cleaning of the drain hose should it ever become plugged without removing the drive, discharge head or screw conveyor.
10. Screen minimum invert to discharge height shall be 133 inches (11'-1").

D. Drive Assembly

1. The rake mechanism and transport screw shall be driven by a direct-connected, cycloidal-bevel, hollow-shaft, high-thrust, right-angle speed reducer. The cyclo element of the speed reducer shall be designed to take a 500 percent shock load without damage. The speed reducer manufacturer shall be a member of AGMA. Combination gear motor designs will not be acceptable for this project. The speed reducer shall have a minimum service factor of 1.11, a torque rating of 33,625 in-lbs. and a minimum thrust rating of 13,000 lbsf.
2. The speed reducer shall be bolted to the drive adaptor flange at upper end of the screenings transport tube.
3. The speed reducer shall be driven by a field replaceable NEMA C flanged, 1,800 rev/min, ball bearing, continuous-duty, totally enclosed, fan-cooled motor with leads to a large conduit box for outdoor operation. The reducer shall utilize a taper grip bushing to connect to the drive shaft of the screw conveyor. The use of keys and keyways will not be an acceptable connection method for this project.
4. Motor size shall be 3 horsepower (minimum) rated for 460 VAC, 3 phase, 60 Hertz electrical power characteristics, rated a non-hazardous environment with installation greater than 18" above the top of the channel.
5. Explosion-proof motor shall be furnished with over-temperature thermostats in the windings designed for cut-out at approximately 160 degrees C.
6. Chain drives, belt drives, hydraulic drives or a separate upper bearing for the transport screw will not be acceptable for this project.
7. A proximity sensor for locating the rake position shall be mounted to the outer drive housing with a fabricated stainless steel bracket. Limit switches or other electro-mechanical position sensing devices will not be acceptable for this project.

E. Spray Wash Systems
   1. Three (3) spray systems shall be provided. Each spray wash system shall be furnished with a control solenoid valve, stainless steel piping and fittings, flexible reinforced PVC hose and nozzles. Piping, fittings and valves shall be ¾-inch diameter minimum. A plant water strainer shall be provided for the incoming plant water supply. The wash water flow requirements shall be 30 gpm (maximum) with a minimum pressure of 60 psi. The three (3) spray wash systems shall include:
      a. Lower spray wash system shall be located near the upper end of the screenings basket just prior to where screenings enter the screw conveyor transport tube. The lower wash system shall have the minimum of 14 spray nozzles.
      b. Screenings spray wash system shall be located in the upper section of the transport tube no more than 17 inches from the beginning of the compaction zone to break up and return organic materials to the flow stream and to ensure maximum screenings washing. A minimum of one (1) spray nozzle shall be provided. The screenings spray wash system and screenings screw conveyor shall be designed to prevent washing screenings down the center of the screw conveyor.
      c. The dewatering chamber flush water system shall periodically clean the compaction and dewatering zone via a stainless steel wash nozzle located in the compaction/dewatering chamber. The dewatering chamber flush water system shall not be a substitute for the screenings washing systems.
   2. The three (3) solenoid valves shall be located greater than 18" above the top of the channel and shall be ¾-inch minimum, brass body suitable for 120 VAC operation with a non-hazardous rating. Solenoid valves shall be normally closed and rated for up to 100 psig. Solenoid valves shall be slow close type to minimize water hammer.
   3. Solenoid valves shall be factory installed to a piping manifold to ensure even pressure distribution to each spray wash system. The solenoid valve wiring shall be factory installed to a common junction box on the spray wash manifold for wire nut connection to external power. Conduit and fittings shall be factory installed between the solenoid valves and junction boxes. Junction box, conduit and fittings shall be rated NEMA 4X for non-hazardous locations.
   4. Water strainer shall be provided suitable for a ¾-inch connection and a 30 gpm maximum flow rate and suitable for a minimum 60 psi pressure. Water filter shall be a stacked filter element design with washable 80-mesh (200 micron) polyethylene or polypropylene disc elements, polypropylene head and bowl and Buna N gaskets or equivalent.

F. Screen Cold Weather Protection
   1. The 3-plane cylindrical bar screen shall be furnished with a heat tracing system for cold weather protection. The screen screenings discharge transport tube shall be furnished with a heat tracing system for outdoor weather protection that shall completely enclose the screenings transport tube, compaction and dewatering zone, screenings discharge drop chute and all spray wash piping, ball valves and solenoid valves.
   2. The cold weather protection system shall include heat tracing, adjustable thermostat, insulation and a fiberglass protective jacket. Heat tracing shall be suitable for an explosion-proof electrical environment when extending below 18 inches of the top of the channel.
   3. The heat tracing system shall be suitable for operation down to a minimum temperature of -20 C (-4 F) and shall be powered from the main control panel.

4. Weather protection system protective cover shall be molded fiberglass reinforced polyester laminate, with the exterior surface gel coated for ultraviolet radiation protection. Fabricated metallic or plastic covers that are bolted or riveted together or covers made of fabric will not be acceptable for this project. Fiberglass shall have a glass content of not less than 30%, a tensile strength of not less than 22,000 psi, a flexural strength of not less than 25,000 psi and Barcol hardness of not less than 40. Finished fiberglass must withstand a temperature of 200o F without blistering, pinholes, warping or other defects. Gel coat shall be provided with impregnated pigment for exterior light gray color. The weather protection package cover shall be designed to support a wind load of 30 lb per square foot.
5. The weather protection package fiberglass cover sections shall be split into two sections when mounted axially along the transport tube. Weather protection system fiberglass cover sections shall extend from the discharge chute over the compaction and dewatering zone and down to the main basket support flange gussets. Each split fiberglass cover section shall be connected via fiberglass flanges and no more than six (6) stainless steel thumb screws for ease of operator access. Each fiberglass cover section shall be designed so that the insulation is completely encapsulated within the fiberglass to prevent water intrusion and damage. Designs utilizing loose fiberglass or foam insulation that are not encapsulated in FRP will not be acceptable for this project. Each fiberglass half section shall be approximately 2 feet long with molded fiberglass flanges. Individual sections shall be connected via fiberglass flanges and a stainless-steel V-ring captive clamping system for easy installation and removal.
6. Where the wash water supply and electrical wiring conduit penetrates the fiberglass cover bulkhead adapters shall be provided.
7. A fabricated composite weather enclosure shall be provided for the water strainer. Enclosure shall be provided with a removable cover.
8. All fasteners to assemble the fiberglass cover components shall be stainless steel.
9. The plant water supply system piping to the screen and the water strainer described shall be provided with heat tracing and insulation by the CONTRACTOR. The MANUFACTURER'S control panel shall be provided with sufficient low voltage power to handle up to an additional 250 watts from the CONTRACTOR supplied plant water heat tracing system.

## 2.3 VORTEX GRIT SEPARATOR EQUIPMENT (GS-101)

A. General
1. The vortex grit chamber shall have an inside diameter 12 feet as noted in the contract drawings.
2. The vortex grit chamber grit hopper shall have an inside diameter of 5 feet as noted in the contract drawings.

B. Drive Mechanism
1. The drive mechanism shall consist of a motor, a helical reduction unit, and an enclosed final reduction unit consisting of one pinion and an integral gear/bearing. All components shall be directly coupled.
2. The speed reducer shall be driven by a C flanged, 1,800 rev/min, ball bearing, continuous-duty, totally-enclosed, fan-cooled motor with leads to a large conduit box for outdoor operation. Motor size shall be a minimum of 1 horsepower shall be rated for Class I,

Division 2, Group D electrical power characteristics. Explosion-proof motors shall be furnished with thermosensors in the motor windings rated T3C for cutout at 160 C.

3. The helical reduction unit shall drive the pinion of the final reduction. The helical reduction unit shall have an AFBMA L10 theoretical design life in excess of 100,000 hours.
4. The final reduction pinion shall be made of heat-treated alloy steel and shall be mounted on the output shaft of the intermediate reduction gearbox. The gear teeth shall have a core hardness of 300-350 BHN, and shall be induction hardened to a surface hardness of 52 to 60 Rc.
5. The external tooth gear shall be an external gear/bearing unit such as manufactured by Rotek, Inc. Kaydon, Inc. or equal. Gear teeth shall be AGMA grade 6 or higher. Gear teeth shall have a core hardness of 250 to 300 BHN, and shall be induction hardened to surface hardness of 52 to 60 Rc. The main gear set shall be rated per AGMA Standard 2001-B88 for one million cycles at a continuous torque load for at least 18,800 ft-lb. The bearing raceway shall be hardened to 58 to 60 Rc, precision ground and have a minimum 20.5-inch ball path diameter. The bearing shall have a seal to prevent contamination of the bearing raceway. The bearing shall have an AFBMA L10 theoretical design life in excess of 100 years. The bearing shall be oil lubricated.
6. The gear/bearing housing shall be sealed and the bottom opening shall be designed to prevent water from entering the housing in case of flooding by means of an air bell.
7. The fabricated and machined steel or cast iron final reduction unit housing shall be provided. All welds shall conform to applicable specifications of the American Welding Society (AWS). After welding, all mounting and mating surfaces shall be machined to insure proper fit and alignment of the drive pinion and mating gear.
8. The surface on which the gear/bearing is mounted shall be machined flat within 0.005 inches.

C. Drive Tube
   1. The drive tube shall be driven by the main spur gear. The drive tube shall have a 10 inch nominal diameter and shall have a minimum wall thickness of 1/4-inches. The drive tube shall be 304 stainless steel construction.

D. Paddle Assembly
   1. The paddle assembly shall consist of four (4) fixed propeller blades. The propeller blades shall be affixed to the drive tube by means of a two (2)-piece collar. The collar shall allow adjustment of the propeller assembly in either an upward or downward position to ensure maximum grit removal.
   2. The paddle blades shall be tapered with ample rounded leading edges and a fixed pitch of 45°. The paddle assembly shall be stainless steel construction.

E. Floor Plate
   1. To minimize the possibility of organic capture, the grit collector shall have a 1/2-inch thick, 304 stainless steel floor plate in the grit chamber. The floor plate shall consist of two (2) removable sections to allow access to the grit storage hopper.

F. Inlet Baffle
   1. A 1/4-inch thick, 304 stainless steel baffle shall be furnished at the inlet channel to optimize the chamber's hydraulic conditions.

G. Grit Airlift Pump
   1. The grit lift unit shall be supplied to remove accumulated grit from the lower grit chamber. The grit lift assembly shall consist of an eductor tube, air-lift supply pipe, air lift diffuser with orifices, and an air scour supply pipe.
   2. The grit lift and air scour assembly shall be fabricated of 304 stainless steel pipe and supported from the grit drive unit. The grit lift eductor tube shall be 4 inches in diameter. The grit lift shall include a manual full-port plug or ball valve the same size as the pipe.
   3. The air-lift supply line for the grit lift assembly shall include a 1-1/2 inch diameter manual brass ball valve and a 1-1/2 inch diameter brass solenoid valve for air flow control. Solenoid valve shall be slow close design to minimize water hammer.
   4. An air scouring device shall be furnished to free the organics that have settled in the grit well. The air scouring supply line shall include a 1-1/2 inch diameter manual brass ball valve and a 1-1/2 inch diameter brass solenoid valve for air flow control. Solenoid valve shall be slow close design to minimize water hammer.

H. Grit Classifier (GC-101)
   1. A grit classifier shall be provided to handle a minimum grit slurry flow rate of 122 gpm. The grit shall comprise a complete stainless-steel assembly including drive, helicoid screw conveyor, fabricated trough with supports and necessary anchorage parts.
   2. The grit classifier screw conveyor shall be driven by a direct-connected cycloidal-helical hollow-shaft high-thrust in-line speed reducer design for a maximum output speed of a 20 rev/min. The cyclo element of the speed reducer shall be designed to take a 500 percent shock load without damage. The speed reducer manufacturer shall be a member of AGMA. Combination gear motor designs shall not be acceptable for this project. The speed reducer shall have a minimum torque rating of 3,370 and a minimum thrust rating of 4,100 lbf at the design output shaft speed of the reducer. The speed reducer shall be bolted to the drive adaptor flange at upper end of the grit classifier tank. The reducer shall utilize a taper grip bushing to connect to the drive shaft of the screw conveyor. The use of keys and keyways shall not be an acceptable connection method for this project.
   3. The speed reducer shall be driven by a field replaceable NEMA C-flanged, 1,800 rev/min, ball bearing, continuous-duty, totally enclosed, fan-cooled, premium-efficiency, 1.15 S.F., fan-cooled motor with leads to a large conduit box for outdoor operation. Motor size shall be ¾ horsepower., shall be rated for electrical power characteristics of 460 VAC – 60 Hertz – 3.
   4. Grit from the grit airlift shall be discharged into the dewatering section of the trough and removed by the helical screw conveyor oriented at a 20 degree angle. The grit screw conveyor shall be capable of handling a maximum of 30 cubic foot/hour of grit. The screw conveyor shall be fabricated with stainless steel flights welded to a rotating 2 1/2 inch diameter stainless steel torque tube. The sectional flights shall be fabricated of 1/4 inch minimum thickness with 1/2 inch wide hardened weld on leading edge. The drive end of the conveyor screw shall consist of 2 inch minimum diameter cold rolled steel shaft bolted to the screw conveyor and held in position with a grease lubricated, flanged roller bearing. The lower end of the screw shall have a 2 inch stainless solid steel end shaft with a grease lubricated bronze bearing.
   5. The speed reducer shall be driven by a C flanged, 1,800 rev/min, ball bearing, continuous-duty, totally-enclosed, fan-cooled motor with leads to a large conduit box for outdoor operation. Motor size shall be a minimum of ¾ horsepower and shall be rated for 460 VAC/3 phase/60 Hertz electrical power characteristics and for a non-hazardous environment.

6. The conveyor screw shall operate in a washing classifying trough fabricated with 1/4 inch stainless steel plate, fitted with a grit inlet and discharge connection. Grit laden wastewater piping from the air lift to the grit classifier and wash water return piping from the grit classifier shall be provided by the CONTRACTOR.
7. The grit classifier unit shall include cold weather protection including heat tracing, insulation, a stainless-steel jacket on the tank and FRP cover for the dewatering screw and discharge area rated for -25 C (-4 F).
8. Explosion-proof motor shall be furnished with over-temperature thermostats in the windings designed for cut-out at approximately 160 degrees C.

I. Grit Air Lift Pump and Grit Fluidizer System Blowers (B-101 & B-102):
1. Two (2) rotary positive displacement blowers shall be furnished with each sized for the requirements of the grit system to provide a minimum of 50 cfm of air at a minimum 5 psig air pressure.
2. The blower shall be driven by a C flanged, 1,800 rev/min, ball bearing, continuous-duty, totally-enclosed, fan-cooled motor with leads to a large conduit box for outdoor operation. Motor size shall be of 3 horsepower and shall be rated for 460 VAC/3 phase/60 Hertz electrical power and shall be rated for a non-hazardous environment.
3. Drive shall be V belt type using sheaves with taper lock bushings designed with a 1.5 service factor.
4. Blower assembly shall be furnished complete with fabricated steel base, combination inlet filter/silencer, outlet silencer, pressure relief valve, flexible connectors, check valve and fiberglass enclosure with louvered air vents.

2.4 Control System

A. All controls necessary for the fully automatic operation of the screen and grit removal system shall be provided.

B. A position sensor shall be located on the drive unit that shall provide a "home" location for the 3-plane cylindrical bar screen operation during the cleaning cycle.

C. The electrical control system shall provide for automatic control of the screen via a high liquid level and high liquid level alarm using a liquid level control float switches in connection with an adjustable time clock. The screen shall operate at a high liquid level or a pre-determined time sequence to provide a variable time between cleaning operations. A second independent float switch shall provide an alarm contact at a liquid level above the screen operation level set point.

D. The float switches shall be a hermetically sealed, axially non-position sensitive type, mercury-switch activated and enclosed in a polypropylene housing. The switches shall operate over a narrow switching angle and have a minimum rating of 1 amp at 120 volts. 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. The switch isolator shall be rated for 120-volt service with output contacts rated for 2 amps minimum.

E. A timer in the PLC shall be used to control the grit airlift pumps. The grit classifier shall be electrically interlocked to the operation of the grit airlift pump solenoid valve and grit fluidizing solenoid valve with an adjustable timer control allowing continued operation of the classifier for interval following termination of the airlift pump operation.
   1. The local mounted main control panel shall include the following items:
      a. Door interlocked fused disconnect.
      b. Allen-Bradley Micrologix 1400 or equivalent Square D, General Electric or approved equal programmable logic controller (PLC) with relays and timers to monitor equipment-mounted electrical devices and to perform necessary logic functions with programmer.
      c. Variable frequency drive (VFD) with line reactor for the screen.
      d. NEMA starter for the vortex grit system drive.
      e. NEMA starters for the blowers.
      f. NEMA reversing starter for the grit classifier.
      g. Control power transformer fused primary and secondary with 120VAC transient voltage surge suppressor (TVSS) and sufficiently sized for the grit classifier weather control heat tracing.
      h. Full voltage LED pilot lights for the following:
         1) Control power on pilot light (White)
         2) Screen running pilot light (Green)
         3) Vortex grit system drive running pilot light (Green)
         4) Blower running pilot light (Green) for each blower
         5) Grit fluidizing system running pilot light (Green)
         6) Grit airlift pump running pilot light (Green)
         7) Grit classifier running pilot light (Green)
         8) Screen heat tracing running pilot light (Green)
         9) Plant water heat tracing pilot light (Green)
         10) Grit classifier heat tracing running pilot light (Green)
         11) Screen high level pilot light (Amber)
         12) Multifunctional overload shutdown/screen fault (Red)
      i. E-stop push button (Red)
      j. System re-set push button (Black)
      k. Hand-Off-Auto selector switches for the following:
         1) Screen drive
         2) Screen wash system solenoid valves
         3) Vortex grit system drive
         4) Blower B11 drive
         5) Blower B12 drive
         6) Grit fluidizing system
         7) Grit airlift pump system
         8) Grit classifier
      l. Forward-Off-Reverse selector switch (spring return to center) for screen and grit classifier.
      m. Door-mounted elapsed time meters for each screen, vortex grit system, blower and grit classifier
      n. Remote dry contact outputs for the following:
         1) Screen Running

2) Vortex grit system running
3) Grit classifier running
4) Blower B11 running
5) Blower B12 running
6) Common malfunction alarm
7) Screen high water level alarm

o. Screen and grit classifier weather protection system heat tracing circuit breaker
p. Plant water heat tracing (250 WATTS MAX BY CONTRACTOR) circuit breaker
q. Flashing alarm light with red LED, 120,000 light source, NEMA 4x; mounted to control panel exterior in water proof enclosure with closed cell neoprene gasket, 65 flashes per minute.
r. White phenolic nameplates with black lettering
s. 600 VAC terminal blocks
t. U.L. 698A label
u. Electrical enclosure, NEMA 4x stainless steel of welded and seamless construction, with sunshield/rainshield.
   1) External hardware, hinges, etc. shall be 300 series stainless steel.
   2) Weatherdoor: gasketed, continuously hinged with doorstop, three-point latch, quick release latches and a hasp assembly for padlocking.
   3) Deadfront / interior swing panel for mounting selector switchers, pushbutton operators, LED indicators, and elapsed time meters. Continuously hinged deadfront shall be held closed with two slotted nickel-plated brass captive panel screws with knurled edges to allow for finger or screwdriver tightening.
   4) Control compartment shall incorporate a fixed, rigid back panel on which control components shall be 12-gauge galvanized steel, painted with heavy-duty epoxy enamel after fabrication. Back panel shall be tapped to accept all mounting screws. Self-tapping screws shall not be used to mount any component.
   5) Mounting provisions: Mounting lugs shall be provided for rack mounted panels.
v. A phase monitor shall be connected to the main power input terminals to prevent motor operation upon phase loss, phase reversal, under-voltage, and phase imbalance conditions. Upon restoration of satisfactory input voltage, the unit shall automatically reset a user programmable time delay. Phase monitor leads shall be fused in accordance with the manufacturer's requirements.
w. A strip heater with thermostat shall be provided to prevent the formation of condensation within the control panel interior.
x. A fluorescent light, switched when the panel door is opened shall be provided for the control panel interior.
y. 120 VAC simplex outlet – 2 Amps maximum.

## 2.5 ANCHOR BOLTS

A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers and hex nuts shall be 304 stainless steel unless noted otherwise. Anchor bolts shall be expansion type or epoxy type stainless steel.

B. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

C. SPARE PARTS
1. The following spare parts shall be provided:
    a. One (1) set of screen rake castings with stainless steel mounting hardware
    b. One (1) complete screen solenoid valve assembly
    c. One (1) screen solenoid valve re-build kit
    d. One (1) screen lower bearing assembly with wear sleeve and seals
    e. One (1) complete grit airlift pump solenoid valve
    f. Two (2) blower inlet filter cartridges
    g. Three (3) spare fuse sets of each size and type

D. SHOP SURFACE PREPARATION AND PAINTING
1. All fabricated carbon steel or cast iron components for submerged service shall be solvent cleaned SSPC SP1 followed by a near white blast cleaning SSPC SP10 and given a 3-mil dry film thickness coat of polyamide epoxy primer.
2. All fabricated carbon steel or cast iron components for non-submerged service shall be solvent cleaned SSPC SP1 followed by a commercial blast cleaning SSPC SP6 and given a 3-mil dry film thickness coat of polyamide epoxy primer.
3. Electric motors, speed reducers, and other self-contained or enclosed components shall be supplied with the manufacturer's standard finish coating.
4. Rust preventative compound shall be applied to all machined, polished, and nonferrous surfaces that are not to be painted.
5. Clean all stainless steel surfaces and provide glass bead blast or chemically treat all external non wetted stainless steel to a uniform finish.
6. Final touch-up and field coating of the primed surface shall be the responsibility of the CONTRACTOR and shall be accomplished in the field in accordance with Section 09 90 00 of these specifications.

E. SOURCE QUALITY CONTROL
1. All structural stainless steel and carbon steel components shall conform to the requirements of "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.
2. All stainless-steel parts and assemblies shall be fabricated from sheets and plates of AISI Type 304 stainless steel conforming to AISI 304 and ASTM A666, unless noted otherwise. Fabricate all rolled or extruded shapes to conform to ASTM A276. All stainless-steel tubular products and fittings shall conform to ASTM A269, A351 and A403.
3. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Add filler wire to all welds to provide for a cross section equal to or greater than the parent metal does. Fully penetrate butt welds to the interior surface and provide gas shielding to interior and exterior of the joint.
4. Field welding of stainless steel will not be permitted.
5. Bolts, nuts and washers shall be AISI 304 stainless steel furnished in accordance with ASTM A193.
6. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005 inches and a concentricity to within 0.005 inches.
7. Design and fabrication of structural steel members shall be in accordance with AISC and AWS Standards. The manufacturer shall comply with the American Welding Society (AWS) and the American Institute of Steel Construction (AISC) most current listed

standards and qualifications in 2004 D1.1, the criteria per the requirements of Section 6 - Inspection - Structural Welding Code. Evidence of such AWS and AISC compliance shall be submitted with shop drawing submittals as follows:

8. AWS Certified Welding Inspectors (minimum 2 on staff) shall conform to all standards, current or previous as listed in section 6.1.4 AWS QC1, Standard and Guide for Qualification and Certification of Welding Inspectors.
9. AWS Non Destructive Testing Inspectors (Level I, II, III) for Magnetic Particle and Ultra-Sonic testing (minimum 2 on staff) shall conform to all standards, current or previous as listed in and in conformance with The American Society for Non-Destructive Testing (ASNT-TC-1A).

## PART 3 EXECUTION

### 3.1 Field Preparation and Painting

A. Finish field preparation and painting shall be performed as previously specified.

B. The CONTRACTOR shall touch up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The CONTRACTOR shall supply paint for field touch up and field painting.

D. The CONTRACTOR shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components with oil resistance enamel.

E. Prior to assembly the CONTRACTOR shall coat all stainless-steel bolts and nut threads with a non-seizing compound.

### 3.2 Installation Assistance and Operator Training

A. After the CONTRACTOR has installed the 3-plane cylindrical bar screen and the grit removal equipment so that it is capable of being operated, the equipment manufacturer shall furnish a qualified representative for a minimum of one (1) days (up to 8 hours) excluding travel time to inspect the equipment, supervise field-testing, start up for the CONTRACTOR and provide training to the OWNER's personnel.

B. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation.

C. Within twelve (12) months after start-up, the manufacturer shall provide one (1) trip and one (1) day (up to 8 hours) of follow-up service and operator training. This shall be exclusive of the start-up service work.

3.3 Shop Testing

A. Prior to shipment of the equipment the screen shall be operated for a minimum of four (4) hours at the fabrication location with the specific drive motor that will be furnished for the project at the actual operating angle of the screen for the project.

B. During the shop test the following parameters shall be recorded:
   1. Motor serial number
   2. Amperage draw at start-up, after two hours and after four hours during forward operation.
   3. Amperage draw during reverse operation
   4. A certified shop test report shall be submitted to the ENGINEER.

3.4 Field Testing and Certification

A. Prior to final acceptance of the screen, three (3) tests shall be conducted according to the EPA Paint Filter Test as described in method 9095 of EPA Publication SW 486.

B. Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

C. Upon completion of the installation and final testing of equipment and controls, the manufacturer shall provide a written certification to the OWNER and ENGINEER that his equipment and controls have been properly installed and operate in accordance with the specifications. Receipt of this certification shall be the commencement of the one (1) year minimum warranty period.

END OF SECTION

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**SECTION 44 46 10**
**SEQUENTIAL BATCH REACTOR (SBR)**
**AND**
**AEROBIC SLUDGE DIGESTION SYSTEM**

# 1 GENERAL

## 1.1 Description

The CONTRACTOR will furnish all labor, materials, equipment and supplies and perform all work necessary for the complete and satisfactory installation of the sequencing batch reactor (SBR) and aerobic sludge digestion system and integration of operation with the existing system as shown on the drawings and described in these specifications.

The SBR and digestion system supplier/manufacturer shall be responsible for all engineering necessary to select, furnish, inspect the CONTRACTOR's equipment installation and connections, calibrate, and place into operation the SBR and sludge digestion system along with all other equipment and accessories specified herein to include but not necessarily limited to the below listed major equipment items:

1.1.1 Sequencing Batch Reactor (SBR) equipment including the following:

A. Influent sluice gates with automatic actuators at SBR Flow Splitter Structure to control the wastewater flow to four (4) SBR units.
B. Influent flow distribution fiberglass manifold piping in existing SBR #1 and SBR #2 basins.
C. SBR #3 and SBR #4 jet aeration and mixing system including influent distribution piping manifold, jet aeration header with jet nozzles, air piping, jet motive submersible pumps and nozzle backwash piping and valves.
D. SBR #3 and #4 floating decanters and related automatic valves.
E. Waste Activated Sludge (WAS) pumps including base elbows and pump retrieval equipment.
F. Hoists for retrieval of WAS pumps.

1.1.2 Aerobic Digester #3, Aerobic digester #4 and Sludge Holding Tank #2 equipment including the following:

A. Jet aeration header with jet nozzles air piping and jet motive submersible pump.
B. Floating decanters and related valves.
C. Aerobic Digester and Sludge Holding Tank Sludge Transfer Pumps including base elbows, pump retrieval system, instrumentation and controls.
D. Hoist equipment for retrieval of submersible jet mixing pumps and sludge pumps.

1.1.3 Aeration Blowers equipment including the following:

A. Aeration blowers for new SBR basins, aerobic digesters and sludge holding tank.
B. Air flow monitors and automatic air flow control valves and related controls for controlling air flow distribution to the new and existing SBR basins, aerobic digesters and sludge holding tanks.

1.1.4. Instrumentation and Controls including the following:

A. All required instrumentation and controls associated with the four (4) SBR basin process control mixing, aeration, air flow control valves, decanting and waste activated sludge transfer operations including integration of existing SBR system into the new controls.

B. All instrumentation and controls associated with the new aerobic digesters and sludge holding tank mixing, aeration and air flow control valves.

C. Integration of the existing digester and sludge holding tank aeration and mixing system into the new process control system to include new air flow control valves on the air supply lines.

1.2 Related Work Specified Elsewhere

| | | |
|---|---|---|
| A. | Section 01 33 01 - | Submittal Procedures, EPMS |
| B. | Section 35 20 16 - | Sluice, Channel and Weir Gates |
| C. | Section 40 71 13.23 - | Insertion-Type Thermal Mass Flow Meter |
| D. | Section 40 92 13.13 - | Electric Motor Actuators |
| E. | Section 43 12 19 - | Positive Displacement Blower Assemblies |
| F. | Section 43 21 39 - | Submersible Pumps |
| G. | Division 26 - | Electrical |

1.3 Quality Assurance

1.3.1 To assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these Specifications that all equipment called for under this Section will be supplied by a single manufacturer/supplier.

1.3.2 As a minimum, the supplier shall be the manufacturer of the following components: jet aeration header systems, decanters and control systems. The SBR System equipment specified in this section will be provided by a single source supplier responsible for the functional operation of all SBR and aerobic digestion system components to ensure coordination and compatibility of equipment.

1.3.3 The Contract Documents represent the minimum acceptable standards for equipment for this project. All equipment will conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications.

1.3.4 If submitted equipment requires arrangement differing from that indicated on the drawings or specified, complete structural, mechanical, and electrical drawings and equipment lists showing all necessary changes and embodying all special features of equipment proposed shall be prepared and submitted. Any changes are at no additional compensation and the CONTRACTOR will be responsible for all engineering costs of redesign by the ENGINEER, if necessary.

1.4 Pre-qualification Requirements

1.4.1 To be considered as an approved supplier, equipment manufacturers must submit a pre-qualification submittal per Specification EJCDC® C-200 -Instructions to Bidders. Qualification packages received after the submittal deadline will not be considered. The pre-qualification submittal shall demonstrate the supplier's ability to meet the project plans and specifications including process performance requirements. The pre-qualification submittal shall include the following information:

A. Design calculations showing SRT, HRT, MLSS, sludge yields, F:M, nitrification rates, AOR, SOR, blower and mixer sizing calculations, and WAS rates.
B. Hydraulic calculations demonstrating cycle structures at minimum, average, and peak day design flows including a detailed description of how the control system responds to changes in flow.
C. Detailed specifications describing the equipment proposed.

D. Draft Process Performance Guarantee including all terms, conditions, and stipulations that will be submitted in the final version.
E. Drawings showing modifications required to the project plans to accommodate the supplier's equipment. Drawings shall detail all changes to mechanical, structural, and electrical sheets.
F. Technical data sheets for packaged components such as pumps, blowers, valves, instrumentation, and controls.
G. A complete list of exceptions to the specifications.
H. Current SBR installation list showing names of contacts and phone numbers.
I. Maintenance schedule including recommended spare parts for 1 year and 5 years operation.
J. Annual operating cost at Average Day Flow condition.
K. List of references for process controls integrator responsible for developing SBR PLC program. Integrator, whether in house or third party, must have at least 25 reference SBR plants, each with at least 5 years of operation.
L. Provide operational data from a minimum of five (5) plants utilizing SBR technology followed by filtration demonstrating ability to achieve the specified performance requirements.

1.5 Delivery, Storage & Handling

Items are to be shipped as complete assemblies except where partial disassembly is required by transportation regulations or for protection of components.

1.6 Basis of Design and Performance Requirements

1.6.1 SBR Influent Wastewater Characteristics

| | |
|---|---|
| Source | Municipal Wastewater + Plant Recycle |
| Average daily flow | 7.1 mgd (6.6 influent + 0.5 plant recycle) |
| Peak daily flow | 16.5 mgd |
| Peak Instantaneous Flow | 18.2 mgd |
| Biochemical Oxygen Demand (5 Day) | 266 mg/l |
| Total Suspended Solids | 272 mg/L |
| Ammonia Nitrogen (NH3) | 35 mg/L |
| Total Kjeldahl Nitrogen (TKN) | 51 mg/L |
| Total Phosphorus | 8 mg/L |
| pH | > 6.5 and < 8.5 units |
| Wastewater temperature (Winter) | 13.5 to 18.5$^{o}$ C |
| Wastewater temperature (Summer) | 24.5 to 27$^{o}$ C |

1.6.2 Effluent Limitations for NPDES Permit Compliance

| | Monthly Average | Weekly Average |
|---|---|---|
| Biochemical Oxygen Demand (5 Day) | 5 mg/L | 7.5 mg/L |
| Total Suspended Solids | 30 mg/L | 45 mg/L |
| Ammonia Nitrogen | 1.0 mg/L | 3.0 mg/L |
| Total Nitrogen | 6.0 mg/L (April – Oct) | N/A |
| Total Phosphorus | 1 mg/L | N/A |
| pH | > 6.5 and < 8.5 units | N/A |

1.6.3 Site & Process Design Parameters

| | |
|---|---|
| Project site elevation | 700 feet MSL |
| Ambient air temperature (Average Daily) | 30 to 85° F |
| | |
| Basin Dimensions: | |
| SBR Basins (2 Exist & 2 New) | 105 ft x 105 ft x 24 ft (22 ft max. water depth)<br>1,814,000 gallons |
| Average Existing SBR Decant Rate | 11,500 gpm |
| Post – Equalization Basin | 212.5 ft x 25 ft x15 ft (11.5 ft max. water depth)<br>457,000 gallons |
| Digester #1 (Exist) & #3 (New) | 65 ft x 45 ft x 24 ft (22 ft max. depth)<br>488,700 gallons |
| Digester #2 (Exist) & #4 (New) | 65 ft x 58.5 ft x 24 ft (22 ft max depth)<br>640,800 gallons |
| Sludge Hold. Tank #1 (Exist) & #2 (New) | 65 ft x 25 ft x 24 ft (22 ft max depth)<br>267,100 gallons |
| | |
| SBR Process Design | |
| Alpha (maximum value allowed) | 0.75 (Relative oxygen transfer) |
| Beta (maximum value allowed) | 0.98 (Relative oxygen solubility) |
| F/M ratio | 0.07 lbs $BOD_5$ /lb. MLSS/day |
| Sludge Yield | 0.82 lbs WAS/lb. $BOD_5$ |
| MLSS at low water level in SBR | 4708 mg/L |
| MLSS at high water level in SBR | 3500 mg/L |
| SBR cycles/day | 4 each 6-hour cycles/day/basin |
| Oxygen Requirements for BOD | 1.29 lbs $O_2$/lb $BOD_5$ applied |
| Oxygen Requirements for Ammonia N | 4.6 lbs $O_2$/lb TKN applied |
| Cycle Time: | |
| Maximum fill time at ADF | 1.5 hrs per basin |
| Anoxic fill time per SBR cycle | 1.5 hrs |
| Aerated fill time per SBR cycle | 0.25 hrs |
| React time per SBR cycle | 2.45 hrs |
| Settle time per SBR cycle | 1.00 hrs |
| Decant time per SBR cycle | 0.65 hrs |
| Idle time per SBR cycle | 0.4 hrs |
| Complete Cycle Time | 6.0 hrs |
| | |
| Existing SBR #1 & #2 Average Decant Rate | 11,500 gpm (per field measurement) |
| | |
| Aerobic Digester #1 & #3 Process Design | |
| Waste activated sludge to Digester No. 1 | 0.85% Solids |
| Solids loading | 12,672 lbs/day (6,336 lbs/day/digester) |
| Volatile solids fraction incoming | 75% |
| Sludge temperature | 50 – 80° F |
| Digester temperature | 68° F |
| Oxygen requirement | 2.3 lbs/lb VSS destroyed |
| % VSS Reduction in Digester #1 & #3 | 12.2% |
| | |
| Aerobic Digester #2 Design Variables | |
| Waste sludge to Digester No. 2 | 2.5% Solids (After thickener) |

| | |
|---|---|
| Volatile solids fraction incoming | 72.5% |
| Sludge temperature | 50 – 80$^{o}$ F |
| Digester temperature | 68$^{o}$ F |
| Oxygen requirement | 2.3 lbs/lb VSS destroyed |
| Design Volatile Solids Reduction | 36.3% |
| | |
| Sludge Holding Basin (SHT) | |
| Average % solids (From Dig #2 & #4) | 1.84% Solids |
| Estimated final digested solids | 8145 lbs/day (4073 lbs/day/SHT) |
| Estimated total solids volume | 53,017 gpd (26,508 gpd/SHT) |

1.6.4 SBR System Operation Description:

A. Anoxic Fill – During anoxic fill, the influent valve is opened allowing raw influent to enter the basin. Mixing is provided but no aeration occurs during this period so that anaerobic and anoxic conditions are present to discourage the growth of filamentous bacteria and encourage phosphorus uptake. The anoxic condition also encourages the growth of well settling, facultative bacteria and denitrification reactions.

B. Aerated Fill - The mixing continues with the aeration system is turned on, allowing biodegradation and simultaneous nitrification / de-nitrification to begin.

C. React - The influent valve is closed. Aeration and mixing continue until full treatment has been achieved. No flow enters the basin preventing potential for short circuiting.

D. Settle - The aeration and mixing system is turned off creating a perfect quiescent condition. Liquid / solids separation occurs.

E. Decant - The effluent valve is opened allowing treated effluent to discharge from the reactor.

F. Idle - The aeration and mixing remain off promoting the development of an anoxic conditions for the start of a new cycle.

1.6.5 Aerobic Digester Operation Description:

A. The aerobic digestion system consists of two (2) existing digesters (No. 1 & No 2) and two (2) new digesters (No. 3 & No. 4). Waste activated sludge (WAS) from the existing SBR system (#1 and #2) is pumped into Digester No. 1 and WAS from the new SBR system (SBR #3 and #4) is pumped to Digester No. 3. These initial digesters provide storage for thickening via rotary drum thickeners (RDT's) or utilization of the manually operated decanters within the respective digesters as well as limited aerobic digestion. Sludge from Digester #1 and #3 can be pumped directly to Digester #2 and #4 or pumped to rotary drum thickeners for gravity thickening prior to transfer to Digester #2 and #4. Piping and valves are also available to permit the transfer between Digester #1 and Digester #3.

B. Digesters #2 and #4 provide for further aerobic digestion to achieve the desired total minimum 40% destruction of volatile suspended solids (VSS). Each of these digesters is to be provided with manual decanters for further thickening the solids within the digester if

desired. Upon completion of the aerobic digestion process, sludge can be transferred to either of the two (2) sludge holding tanks (SHT's) or directly to tank trucks for land application.

C. SHT # 1 (existing) and SHT #2 (new) provide storage for the final digested sludge and limited additional aerobic digestion for dewatering or land application. It is also possible to transfer sludge between the two SHT's to permit dewatering by either dewatering system.

D. Digester #3, Digester #4 and SHT #2 are to be provided with jet mixing and aeration permitting aeration to be cycled on and off by a timer control system to maintain the desired dissolved oxygen levels.

1.7 Specification Precedence

A. The valves, equipment, materials of construction and controls specified under this section supersedes valves, equipment, materials of construction and controls specified elsewhere in the contract documents.

B. The SBR, Digester, Sludge Holding and Post Equalization tank areas up to eighteen (18) inches above the tank access walkways shall be considered a hazardous electrical classification location. Motors within these basins shall be designated Class I, Division II, Group D and rated for a temperature code T2A (280$^{o}$ C).

## 2 PRODUCTS AND EQUIPMENT

2.1 General

2.1.1.1 The supplier/manufacturer of the SBR and aerobic digester system will be completely responsible for the proper design of the overall system process equipment and controls, including but not limited to; aeration blowers, jet motive pumps, jet headers, aeration headers, influent diffuser piping, decanters and related valves and controls to supplement the existing SBR and digesters process. All equipment shall perform as specified and the completed installation shall operate in accordance with the requirements of the plans and specifications.

2.1.1.2 The aeration system shall be designed to provide oxygen distribution to the entire basin. It shall also ensure mixing to promote biological suspension of all solids in the basin without the introduction of air. No change in the basin geometry will be allowed. The velocity and mixing in the basin shall be sufficient to ensure complete biological solids suspension and dispersion.

2.1.1.3 The aeration and mixing system shall be capable of providing mixing such that when operated under any combination of the design conditions in this specification, it shall suspend all biological floc and mixed liquor suspended solids throughout the liquid mass in each basin. The system shall further be capable of maintaining complete aerobic conditions throughout the liquid mass in each basin.

2.2 SBR Influent Flow Control

2.2.1 Division of flow between the two (2) existing and two (2) new SBR basins is to be provided at the SBR Influent Flow Splitter structure utilizing four (4) electrically actuated sluice gates for each SBR basin. The gates are to be operated automatically by the SBR control system. The

structure is designed such that influent flow will overflow to all four SBR basins should the gate(s) fails to open. During peak flow events, influent may be diverted to multiple SBR basins.

2.2.2 See Specification Section 35 20 16 Sluice, Channel and Weir Gates and Section 40 92 13.13 Electric Motor Actuators. The SBR manufacturer shall be responsible for supplying gates, actuators and related controls for the following listed gates as shown on the drawings:

Table No. 2.2.2

| Gate Identification | Gate Location | Gate Type | Size W x H | Actuator Mounting |
|---|---|---|---|---|
| MSG-201 | SBR Flow Splitter | Channel Gate | 24" x 24" | Yoke |
| MSG-202 | SBR Flow Splitter | Channel Gate | 24" x 24" | Yoke |
| MSG-203 | SBR Flow Splitter | Channel Gate | 24" x 24" | Yoke |
| MSG-204 | SBR Flow Splitter | Channel Gate | 24" x 24" | Yoke |

2.3 SBR Basin Influent Flow Pipe Manifold

2.3.1 An influent pipe manifold as shown on the drawings shall be provided for all four (4) SBR basins and shall be designed to distribute the influent flow evenly across the reactor floor during the fill period. Manifolds shall be sized such that the exit velocity through the openings at peak flow conditions is equal or less than 0.5 feet per second.

2.3.2 Manifolds shall extend a minimum of 50% across the basin length and shall terminate in a flanged connection as shown on the plans.

2.3.3 Manifolds shall be constructed of filament wound fiberglass reinforced plastic (FRP) manufactured in accordance with ASTM D-2996 standards.

2.3.4 The influent manifolds within the existing SBR #1 and #2 basins shall be designed for independent support of the influent pipe manifold and to withstand the mixing forces of the floating mixers and retractable diffused aeration assemblies within these basins. The manifold support shall be constructed of 304 stainless steel and designed to accommodate the sloped bottom.

2.3.5 Influent manifolds within the new SBR #3 and SBR #4 basins shall be incorporated into the supports for the jet and air manifolds as shown on the plans.

2.4 Jet Aeration Headers

2.4.1 The jet aeration system shall be designed for required process mixing and oxygen transfer within each basin. Dual directional aeration manifolds shall be provided in each SBR, Digester and Sludge Holding Tank basin as shown on the drawing. Each manifold shall consist of liquid jet motive line, air line, and jet nozzle assemblies. The liquid line, air line, and jet nozzles shall be permanently laminated together to form an integral assembly. The manifolds will be shipped to the jobsite in section up to 40' in length. Fiberglass field weld kits shall be provided to connect

manifold sections in the field. Labor to apply the field weld kits shall be provided by the installing contractor.

2.4.2 Re-circulated liquid from the SBR shall enter the lower liquid manifold through a flanged connection as shown on the plans. The liquid header shall be cylindrical having jet nozzles mounted on a horizontal or angular plane. Liquid flow path shall be free of burrs or rough edges that may collect debris.

2.4.3 Low pressure air shall be fed through the upper air line and air drop pipe which will terminate with a flanged connection near the top of the SBR basin. The air line shall also be cylindrical and mounted above and parallel to the liquid manifold. The air line shall be provided with orifices which allow the flow of air into the air chambers mounted to each jet assembly. The air chamber shall provide a flow path for the air to enter the outer air jet and shall also act as a support to hold the air line in place. Individual feeds at each jet shall insure uniform distribution of air across the length of the manifold.

2.4.4 The liquid and air piping shall be fabricated of corrosion resistant, structurally sound, machine filament wound thermosetting resin pipe conforming to ASTM D2996. Minimum pressure rating of piping shall be 75 psi. Internal pressure ratings shall exceed 5:1 safety factor for short term burst per ASTMD-1599 and shall exceed 1.8:1 safety factor based on ASTM D-2992 for long term hydrostatic design basis (HDB) per AWWA C-950. Hand layed FRP piping, PVC, stainless steel, or any other types are not acceptable. Minimum acceptable pipe wall thickness (including 20 mil corrosion liner) shall be per the following table:

Table 2.4.4

| Diameter | Minimum Wall Thickness * |
|---|---|
| 4” | 0.100 |
| 6” | 0.145 |
| 8” | 0.145 |
| 10” | 0.185 |
| 12” | 0.185 |
| 14” | 0.230 |
| 16” | 0.270 |
| 18” | 0.270 |
| 20” | 0.315 |
| 24” | 0.350 |
| 30” | 0.440 |

* Includes 20 mil corrosion liner

2.4.5 Jet nozzle assemblies shall be provided in each SBR basin as shown on the drawings. Each jet aerator assembly shall consist of an inner liquid nozzle, and an outer air/liquid delivery nozzle. The jets shall be molded and assembled to be concentric with the inner liquid and outer air/liquid discharge nozzle in axial alignment. The air/liquid discharge nozzle shall be of constantly decreasing cross sectional area to increase the velocity of the air / liquid mixture as it passes through the nozzle. The inner liquid nozzle shall be constantly reducing in the direction of the flow path. The outer air jets shall also be constantly reducing in the direction of the flow path and shall

be designed to achieve substantial air entrapment in the motive liquid. The outlets of both the inner and outer nozzles shall be circular and shall be designed to pass a 2" solid spherical. The inner and outer nozzles shall be laminated together to form a single unit. The jet aerator assembly shall be joined to the liquid duct and the air manifold and laminated for strength to form a single integrated unit. Systems with non-integral jets will not be accepted. The base of the jet aerator assembly shall match the contour of the liquid pipe to provide a smooth liquid flow path. No portion of the jet nozzle assembly shall protrude into the liquid pipe.

2.4.6 Molded parts (inner nozzles, outer nozzles, air chambers) shall be fabricated of isophthalic or vinyl ester laminating resin, reinforced with chopped strand mat to create a minimum nominal laminate thickness of 3/16". The interior of each air and liquid nozzle shall contain a chemical and abrasion liner consisting of a minimum of 2 layers of 0.010-inch synthetic Nexus or C-glass surfacing veil. The interior liner shall be a resin-rich surface layer containing no more than 20% by weight of glass. Exterior of outer nozzles and air chambers shall be protected with a separately cured gel coat containing a wax solution and either pigmented or provided with UV inhibitor to protect from UV degradation. All construction and laminate quality guidelines shall be in accordance with the National Bureau of Standards (NBS) PS 15-69.

2.5 Air Piping

2.5.1 In-basin air drop pipe shall be provided by the aeration system manufacturer. The air drop pipe shall connect to the airline of the jet manifolds by FRP flanged connections. The upper end of the air drop shall terminate with a flanged connection near the top of the tank wall as shown on the plans. Hardware required to complete this flanged connection will be supplied by the Contractor. In-basin air piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated in accordance with ASTM D-2996. Any in-basin air piping beyond the air drop flanged connection shall be by the Contractor. All flanges connecting to FRP must be flat faced.

2.6 Airlift Flushout System

2.6.1 Each jet aeration header shall include provisions for back flushing the header nozzles by utilizing of the aeration supply to create an airlift pumping action at an outlet pipe reversing the flow within each nozzle to clear possible obstructions.

2.7 Liquid Piping

2.7.1 In-basin process equipment shall include adequate pipe, fittings, and supports to connect to Contractor supplied flanged interfaces as indicated on the plans. A flanged connection shall be provided at this interface point, and hardware to complete this flanged connection shall be supplied by the Contractor. In-basin liquid piping shall be machine filament wound, fiberglass reinforced thermosetting resin pipe fabricated in strict accordance with ASTM Specification D-2996. All flanges connecting to FRP must be flat faced.

2.8 Supports

2.8.1 Aeration equipment, in-basin liquid and air piping, flow control manifolds, and decanters shall be provided with adequate supports to accommodate loads and buoyancy factors experienced by the equipment during operation. Jet manifold supports shall be of the "H" type utilizing a cross support with two Schedule 40 support legs welded to a base plate. Single leg supports used for other in-basin piping shall be constructed of Schedule 40 pipe field welded to a support base. Supports shall

be designed to allow for vertical adjustment of equipment to maintain elevations as indicated on the plans and varying floor elevations. Field welding of supports shall be by the Contractor. Supports shall be constructed of type 304 stainless steel.

2.8.2 Pipe supports shall consist of a contoured upper and lower saddle constructed of 3/16" thick stainless steel with a Buna-N or neoprene liner to prevent abrasion of the FRP. Base plates shall be anchored with anchor bolts and grouted in place, if necessary. Anchor bolts and fastening hardware shall be Type 304 stainless steel.

2.9 Anchor Bolts

2.9.1 Anchor bolts shall be provided for mounting in-basin equipment provided by the SBR manufacturer. Anchor bolts shall consist of stud, flat washer, lock washer, and hex nut. Anchor bolts shall be constructed of type 304 stainless steel. Anchor bolts shall be adhesive type utilizing an acrylic resin and hardener contained in a dual cartridge with static dispensing nozzle. Anchor bolts must be installed to full embedment depth. Mechanical or expansion anchors are not acceptable.

2.10 Jet Motive Pumps

2.10.1 The SBR supplier shall be responsible for supplying the pumps listed in the below table and the related auxiliary equipment and controls required for combined new and existing SBR equipment to operate in concert as a four (4) basin SBR system. Pump shall be as specified in Specification Section 43 21 39 – Submersible Pumps.

2.10.2 The existing SBR #1 and SBR #2 mixers (M-1 and M-2) operation controls shall be integrated into the new SBR control system to facilitate the operation of a four basin SBR system.

2.11 Positive Displacement Blowers

2.11.1 See Specification Section 43 12 19 – Positive Displacement Blower Assemblies. The SBR and digester supplier/manufacturer shall be responsible for providing the blowers and related controls for the new SBR's, aerobic digesters and sludge holding tank served from an aeration manifold with aeration controlled by air flow meters and automatic control valves.

2.11.2 The SBR and digester supplier/manufacturer shall be responsible for the coordination and integration of the existing SBR, digester and sludge holding tank blowers into the control system. The distribution of air from the aeration blower manifold to the existing SBR, aerobic digesters and sludge holding tank units shall be controlled by the addition of new air flow meters and automatic control valves.

2.12 Valve and Valve Actuators

2.12.1 Valves directly related to the SBR process, digestion and sludge holding tank aeration and flow control as specified in the Table 2.12.1 below shall be provided by the SBR supplier/manufacturer. Electric actuators shall operate from 460 volts, 3 phase, 60 Hz per source. Other manually operated valves related to sludge wasting, sludge transfer between digesters or sludge holding tanks and basin drains shall be supplied by the Contractor per Specification 40 20 00 –Process Piping, Fittings Valves and Accessories.

| Table 2.12.1 SBR Process, Digestion & Sludge Holding Tank Aeration Valves | | | | |
|---|---|---|---|---|
| Function | Quantity | Size | Type | Operator |
| SBR #3 and #4 Effluent Decanters | 2 | 24-inch | Butterfly | Electric |
| Aeration to SBR #1 & #2 | 2 | 12-inch (existing) | Butterfly | Electric (To be modified for modulation) |
| Aeration to SBR #3 & SBR #4 | 2 | 12-inch | Butterfly | Electric |
| Aeration to Digester #1, Digester #2 and SHT#1 | 3 | 8-inch | Butterfly | Electric |
| Aeration to Digester #3, Digester #4 and SHT#2 | 3 | 8-inch | Butterfly | Electric |
| Jet Aeration Flushout | 8 | See Drawings | Plug | Manual |

2.12.2 Plug Valves: All plug valves shall be permanently lubricated and shall be of the tight-closing, rubber seat type. Valves shall be suitable for sewage and wastewater application, shall have throttling capability, and shall be rated 150 lb. WOG. Valve bodies shall be cast iron. Valve plugs shall be balanced type and constructed of either cast iron or ductile iron. Passage size shall be a minimum of 80% of the full port area for valves through 20" size and a minimum of 70% of the full port area for valves 24" and larger. Upper and lower bearing shall be either stainless steel or bronze and permanently lubricated. Packing shall be O-ring, U-cup or V-type, and shall be self-adjusting or externally adjustable by means of an external packing gland. Packing gland shall be visible through a standoff between the valve bonnet and actuator base. Packing shall be replaceable without removing the valve actuator or bonnet. All valves shall be leak tested to their full rating prior to shipment. Manual plug valves shall have worm gear actuators with handwheels. Actuators shall be sized for 50 PSI reverse shut off pressure against the face of the plug. Gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant. Seals shall be provided on all shafts to prevent entry of dirt and water into the actuator.

2.12.3 Butterfly Valves: Valves shall be specifically designed for air service and clean water service. All valves shall have a maximum of 50 PSI pressure rating and valves for air service shall have a temperature rating of 250°F. Valves shall be either wafer or lug design with cast iron body. Valve disc shall have an uninterrupted 360° seating surface and shall be aluminum bronze, ductile, or cast iron with an appropriately suitable edging. Shafts shall be one piece and shall be of hi-strength carbon steel with phosphate coating, or stainless steel. Shaft bearings shall be self-lubricating, and corrosion resistant. Packing materials shall be either adjustable or self-adjustable and shall be suitable for the intended temperature and service conditions. Manual butterfly valves 4" and smaller shall be provided with lever actuators. Manual butterfly valves 6" and larger shall be provided with geared actuators with handwheels. Valves shall be sized appropriately for the service conditions and specific application. Lever operated valves shall latch in the open, closed, or several intermediate positions. Gearboxes shall be self-locking.

2.12.4 SBR Decant Flow Control Valves: One (1) 24"-inch diameter butterfly valve(s) for SBR #1 and SBR #2 basins shall be provided to control the decant rate. Each valve shall be a 24" lugged style influent butterfly valve with a cast iron body, aluminum bronze disk, stainless steel shaft, EDPM seat and gear operator and hand wheel. Each valve shall have a valve stem extension constructed of

304 stainless steel to permit valve operation from walkway above valve as shown on the drawings. Intermediate valve supports shall be provided by the CONTRACTOR. The electric motor operators shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA 4X/6 housing. Actuators shall be sized for 50 PSI working pressure. Actuators shall be supplied with local Open / Stop / Close pushbuttons, Local / Off / Remote selector switch, and Open / Close / Fault indicating lights. Open / close switches shall also be provided for hand operation of valves at the SBR control panel.

2.12.4 The motor shall be of the high torque type, designed for a minimum 15-minute duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. Actuators shall be provided with integral motor starters (if required). All termination caps shall be plug and socket connection permitting removal without disturbing field wiring. Power for all automatic valves shall be the responsibility of the installing contractor. Valves shall not be powered from the SBR control panel.

2.12.5 The integral self-locking power gearing shall be compound epicyclic or combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high speed parts running on anti-friction bearings. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor. Motor wiring shall be connected by plug and socket connection.

2.12.6 The hand wheel shall not rotate during electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the actuator motor is energized. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically. The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or gear mechanism. Clockwise rotation of the hand wheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit.

2.12.7 Failure of the motor or motor gearing shall not hinder manual operation. Limit switches set at the open and close positions shall be provided. Limit switch adjustment shall be possible with no more than 5 turns of the limit adjuster. Switches shall be mechanical and shall include provisions for powered or isolated contacts for remote indication.

2.12.8 A double-acting torque limiting switch shall be provided, which is responsive to the mechanical torque developed by seating or an obstruction. Torque shall be directly measured from the worm shaft through a series of compressible washers and mechanical torque arm and switch.

2.13 SBR Process Decanters

2.13.1 Floating decanters shall be provided in SBR Basin #3 and SBR #4 to remove treated effluent from the SBR reactor. Decanters shall be designed to accommodate the full range of travel between top water level (TWL) and decanter rest elevation and shall remove a full SBR decant volume within the time specified for the SBR process design.

2.13.2 The SBR decanter control system shall integrate the existing SBR #1 and #2 decanters with an average decant rate of 11,500 gpm into the process control system.

2.13.3 Decanter main components and materials of construction shall be as outlined in the Table 2.13.1 below.

Table 2.13.1 SBR Decanter Components

| | |
|---|---|
| Float | ASTM D2996 FRP filled with closed cell foam |
| Draw tube | ASTM D2996 FRP |
| Drain tube | ASTM D2996 FRP |
| Flex connector | Natural Rubber / Neoprene (wire re-enforced) |
| Knee joint assembly | 304 stainless steel |
| Lower mitered elbow | 304 stainless steel |
| Decanter rests | 304 stainless steel |

2.13.1 The draw tube and float assembly are located in parallel and permanently connected using laminated FRP supports. The drain tube is located in the center of the draw tube and provides a flow path for effluent to exit the basin through the flex hose and lower mitered elbow. Miter joint connecting the draw tube and drain tube must be re-enforced with FRP hoop wraps to provide added strength. Drain tube, flex connector, and lower mitered elbow shall be connected by flanged connections with hardware and gaskets provided by the manufacturer. A knee brace assembly shall be provided to allow vertical articulation of the decanter as water levels move up and down in the reactor. The knee brace assembly shall support the flex connector and prevent lateral movement of the decanter unit. Flex connector shall be suitable for abrasive materials and shall be rated at 30 inches mercury vacuum and 15 PSI working pressure. Fixed or retractable decanters will not be accepted.

2.13.2 The draw tube shall contain an adequate number of solids excluding valves (SEV) to accommodate the average design flow rate based on site hydraulic conditions. The SEV assemblies are designed to isolate the draw tube from the surrounding mixed liquor during the mixing and aeration steps. SEV assemblies shall be mounted to the draw tube using hardware connections to allow for field replacement. The SEV assembly shall consist of stainless steel body, orifice plug with drive rod, stainless steel compression spring, and mounting hardware / gasket. The SEV assemblies shall maintain a liquid tight seal when the effluent control valve is closed. When the effluent control valve is opened, hydraulic head differential is used to over-come the compression spring tension which allows the plugs to un-seat and treated effluent is allowed to enter the draw tube. Plant hydraulics must be such that a minimum of 3.5 feet of static head differential (plus out of basin pipe friction losses) is available between SBR bottom water level and the water level at the effluent discharge. The point of effluent discharge downstream of the SBR shall be either constantly submerged or designed with a water trap. Decanters must employ positive mechanical type seals for excluding solids from the draw tube. Decanters having an open conduit or any open areas exposed to the mixed liquor during react, or that require additional equipment or motors for pressurization, wear movement, or complete removal out of the liquid, are unacceptable.

2.14 Digester Floating Decanters

2.14.1 Description - Two (2) floating decanters and related equipment shall be provided for Aerobic Digester #3 and #4. Each decanter shall consist of a withdrawal manifold with orifices, a single foam filled float, and shall be capable of intermittent operation. The decanter assembly shall be constructed of machine filament wound, fiberglass reinforced, thermosetting resin pipe fabricated in

strict accordance with ASTM Specification D-2996-01. The decanters shall be designed to be capable of withdrawing the effluent at an average rate of approximately 1000 gallons per minute. Actual flowrate may vary +/- 20% of design at any point in time during decant. Each orifice shall allow equal flow into the draw tube. The hydraulic differential provided shall be a minimum of 2.0 feet (plus pipe friction losses) determined as the differential head, under flowing conditions, between reactor bottom water level and top water level at the downstream discharge.

2.14.2 The draw tube, containing the orifices for removal of supernatant shall be integrally attached to the foam filled float such that the float remains level throughout the full range of operation, and to maintain submergence of the orifices of the main body. The main body will be connected to the effluent piping by means of a flanged stub. The effluent pipe shall include a "knee" joint to allow vertical movement. The "knee" joint shall be wire reinforced rubber hose with a flange at each end, and include a support mechanism that allows vertical articulation, but precludes lateral or twisting movement. Hose shall be suitable for abrasive materials and shall be rated at 30 inches mercury vacuum and 15 PSI working pressure. The effluent pipe shall be provided with a flanged connection for mounting the decanter system to the installed pipe through the basin wall. Flange connection shall be in accordance with ANSI standard 150-pound bolt pattern. Hardware at this flanged connection interface shall be furnished by the contractor.

2.14.3 Supports. All necessary supports for the decanter mechanism shall be provided. The supports will be located on the basin floor and will support the decanter mechanism when the basin is dewatered. The supports shall be fabricated of 304 stainless steel for corrosion resistance. The supports shall consist of a support plate welded to a supporting base. The base shall be anchored with anchor bolts and grouted in place, if necessary. Fastening hardware shall be Type 18-8 stainless steel.

2.14.4 Performance

The floating weir decanters shall be capable of withdrawing decant fluid from 4-6 inches beneath the liquid surface, regardless of liquid depth, down to a minimum level of liquid depth specified below.

A. Maximum allowable water depth in the basin is 22 feet
B. Minimum allowable water depth in the basin is 15.4 feet.
C. Center line of each decant pipe to be located 1 foot below the low water level by the Contractor.

2.14.5 Weir Decanter Discharge Pipe - The floating decanters shall include an 8-inch diameter discharge hose of sufficient size to permit vertical movement of the floating weir and provide sufficient capacity to handle the design decant flow rate. The discharge hose shall be a wire reinforced rubber hose suitable for abrasive materials and shall be rated at 30 inches mercury vacuum and 15 PSI working pressure. The effluent pipe shall be provided with a flanged connection for mounting the decanter system to the installed pipe through the basin wall.

2.14.6 Weir Decanter Restrained Mooring System - The equipment supplier shall furnish as part of the floating weir assembly a 304 stainless steel mooring frame which shall permit the assembly to move up and down following the changes in liquid level while restrained within the vertical pylons.

The float shall moor with a restrained mooring system consisting of two- 4" diameter Schedule vertical pylons with base plates constructed of 304 stainless steel. Each pylon with base plate shall be affixed to the basin floor with Type 18-8 stainless steel adhesive anchors. Each pylon shall be filled with concrete by the CONTRACTOR.

2.14.7 Floating Weir Decanter Operating Valves - The CONTRACTOR shall furnish one 8-inch diameter manual operating plug valve to control the decant rate for each digester decanter as shown on the drawings. The valve shall be 125# flanged end connection and connection, ASTM A-126 Class cast iron body with welded nickel seat, neoprene resilient plug facing. The valve shall be non-lubricated type with a port opening of at least 80% of full pipe size.

The valve shall include a 13-foot valve stem extension constructed of 304 stainless steel. Intermediate valve supports, and hardware required for mounting shall be provided by the CONTRACTOR.

2.15 Sludge Transfer Pumps

2.15.1 See Specification Section 43 21 39 – Submersible Pumps. The SBR/Digester supplier/manufacturer shall be responsible for supplying the sludge transfer pumpsand the related auxiliary equipment and controls required for the new and existing SBR waste sludge pumps to operate in concert as specified as a four (4) basin SBR system.

2.16 Pump Hoist Equipment

2.16.1 A 304 stainless steel hoist assembly shall be provided for use with the jet motive and sludge pumps as shown on the drawings. The hoists shall be rated for a safe load exceeding the weight of the pump or a minimum of 500 lbs. The hoist shall be capable of a lift of 26 feet plus the height of the pump with a minimum 36” reach permitting removal of the pump from the basin to the walkway without a intermediate lift. The hoist shall consist of a minimum 1/4" diameter, 304 stainless steel cable, painted steel lifting hook, and 304 stainless steel snap hooks.

2.16.2 A 304 stainless steel platform socket assembly shall be provided for installation at each of the pump locations as noted on drawings. Field attachment/welding of the platform sockets shall be the responsibility of the Contractor.

2.17 Air Flow Meters

2.17.1 See Specification 40 71 13.23 – Insertion-Type Thermal Mass Flow Meters.

2.17.2 Air flow meters with upstream air flow conditioners shall be provided on the air supply lines to the all four (4) SBR basins, four (4) Digesters and two (2) Sludge Holding Tanks as shown on the drawings to monitor air flow and provide a 4-20 mA signal for controlling an upstream motor operated butterfly valve at preset air flow rate.

2.18 Pressure Transducers and Float Switches

2.18.1 Submersible pressure level transmitters shall be provided for each SBR basin, digester, sludge holding tank and SBR post equalization basin (6 total). Transmitters shall be rated IP 68 for permanent submersion in water and wastewater. Body material shall be stainless steel with 3 wire polyurethane shielded cable. Output shall be 4-20 mA with an accuracy of 0.25% of span. Transmitters shall be WIKA Model LS-10 or approved equal.

2.18.2 A 4" diameter schedule 40 PVC stilling well shall be provided to house each transmitter. Stilling wells shall contain equalization ports facing the wall and shall extend from a point six inches above

the floor to a point six inches below the top of the wall. Stainless steel mounting supports shall be provided by the manufacturer.

2.18.3 One (1) float switch shall be provided for each SBR basin, digesters, sludge holding tank and SBR post equalization basin (6 total). The float shall be mounted 12" above the normal TWL and shall indicate an emergency top water level condition. Float shall be Type S Roto Float as manufactured by Anchor Scientific, or equal. Stainless steel mounting brackets shall be provided by the manufacturer for each float switch.

2.19 Dissolved Oxygen and pH Monitoring Control System

2.19.1 A modular dual channel controller shall be provided for monitoring pH/ORP and dissolved oxygen (DO) levels within SBR basins #3 and #4.

2.19.2 The controller shall be a Hach SC200 Universal Controller or approved equal for operation on 100-240 volt AC and with one digital sensor input, one analog pH/ORP/DO sensor input and two 4-2-mA outputs.

2.19.3 Performance Requirements

A. pH/ORP sensor mode -
   1. pH: -2.0 to +14.0
   2. Repeatability: 0.1% of range or better
   3. Response Time: 0.5 s

B. DO sensor mode –
   1. Measurement Range: 0 to 2000 ppb
   2. Repeatability: +/- 0.05 ppb or 5% whichever is greater
   3. Response Time: (t90%) for step change between 1-40 ppb: < 30s

C. Operational Criteria
   1. Temperature: -4 to 140.0 $^{o}$F.
   2. Relative Humidity: 0-95%, non-condensing

2.19.4 A handrail bracket and PVC pipe shall be provided for each sensor for installation to the side of the basin. Field wiring, conduit, and installation of cable shall be the responsibility of the CONTRACTOR.

2.19.5 The pH sensors shall provide an input signal to the SCADA system to allow continuous monitoring of the pH and DO levels within each of the two (2) new SBR basins. Contact closures and outputs shall be provided within the control system for each SBR basin to allow the automatic on/off control for automatic operation of caustic feed pumps for the SBR basins between two (2) selected pH set points and alarm for low and high pH levels with a dead band at low and high alarm levels.

2.19.6 The dissolved oxygen sensor shall be capable of automated control of the SBR blower variable speed drives based upon dissolved oxygen level within the SBR basins.

2.19.7 The following accessories shall be provided with each unit:
A. Weather protection shield.
B. Sun screen.
C. RS-232 / RS-485 MODBUS output card.

2.20 Process Control

2.20.1 The control system shall integrate the existing SBR and post equalization controls into the new process control for the operation of the SBR process utilizing up to four (4) SBR basins and two (2) post equalization tanks. The control shall also permit the flexibility for the operator to designate individual SBR basins to be removed from service with the continued automatic operation of the remaining SBR basins as a three (3) or two (2) SBR basin process.

2.20.2 The control system shall be designed to optimize the SBR, post equalization, digester and sludge holding tank system processes while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

2.20.3 The control system shall be a timer-based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows as follows:

A. The SBR system is to operate as an integral 4-tank SBR batch mode system for flows up to 2 times the design flow (Q). Only an integral 4-tank system will be acceptable.
B. The process controls shall have the capability to designate the number of SBR tanks in operation to permit system operation as a 2 tank, 3 tank or 4 tank process. Processes that operate as a 2-train, 2 tank process will not be accepted.
C. When peak flow are > 2 Q, the system shall operate as a continuous fill batch process with all four (4) SBR units receiving flow.

2.20.4 A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include a circuit breaker disconnect, control transformer, branch circuit breakers, microprocessor control, indicator lights, HAND-OFF-AUTOMATIC selector switches.

2.20.5 The incoming service of the control system for the new equipment and controls shall be 115-volt, 60 hertz, single-phase. Motor starters for the new equipment listed below shall be provided within a motor control center by the Contractor as shown on the contract drawings.

| Qty | SBR # 3 & #4 Equipment Description |
|---|---|
| 4 | Jet Motive Pumps |
| 3 | Waste Sludge Pumps* (1 pump to be shelf spare) |
| 4 | SBR Aeration Blowers * |
| 4 | Influent Sluice Gates |
| 2 | Decanter Effluent Valve Actuators |
| 2 | 4-20 mA Pressure Transducers |
| 2 | 10” Air Control Valves |
| 1 | Common Alarm |
| 2 | Level control systems |
| 2 | Oxygen/pH sensors systems |

| Qty | Post Equalization #2 Equipment Description |
|---|---|
| 5 | Transfer Pumps * |

| | |
|---|---|
| 1 | 4-20 mA Pressure Transducer |
| 1 | Level sensor |

| Qty | Digester No.3 Equipment Description |
|---|---|
| 1 | Jet Motive Pump * |
| 1 | Sludge Transfer Pump * |
| 2 | Digester Aeration Blowers * |
| 1 | 4-20 mA Pressure Transducer |
| 1 | Level sensor |

| Qty | Digester No.4 Equipment Description |
|---|---|
| 2 | Jet Motive Pumps * |
| 1 | Sludge Transfer Pump * |
| 2 | Digester Aeration Blower * |
| 1 | 4-20 mA Pressure Transducer |
| 1 | Level sensor |

| Qty | Sludge Holding Basin #2 Equipment Description |
|---|---|
| 1 | Jet Motive Pump * |
| 1 | Sludge Transfer Pump * |
| 1 | 4-20 mA Pressure Transducer |
| 1 | Level sensor |

* Elapsed time indication shall be provided through the operator interface of the SBR control panel for equipment.

2.20.6 A process control panel to control sequencing and operation of the SBR equipment shall be provided by the SBR supplier/manufacturer. Control panel enclosure shall be rated NEMA 12 and shall be constructed of 12-gauge steel with ANSI 61 gray powder paint exterior finish and white, polyester powder paint inside. Enclosure shall include 3-point latch with locking handle and thermoplastic data pocket and shall be located within the existing office/lab building adjacent to the existing control system.

2.20.7 The existing process control panel installed for SBR Basins #1 and #2 includes the below listed components that are to be integrated into the final control system:

A. Allen-Bradley CompactLogix PLC 1769-L32E
B. Allen-Bradley CompactLogix Power Supply 1769-PA4
C. Allen Bradley Panelview 600 2711-K6C20
D. Allen Bradley CompactLogix 32-Point Solid State 24V dc Source Output Module 1769-OB32
E. Allen Bradley CompactLogix 32-Point 24V dc Sink/Source Input Module 1769-IQ32
F. Allen Bradley CompactLogix Individually Isolated AC/DC Relay Output Module 1769-OW8I
G. Allen Bradley CompactLogix Analog I/O Modules 1769-OF8C and 1769-IF16C
H. Allen Bradley 24VDC Power Supply 1606-XLP50E

2.20.8 A programmable logic controller (PLC) shall be utilized to control sequencing of the SBR. PLC shall include 750 kbytes of battery-backed static RAM, Ethernet IP port, RS232 port, and shall be capable of supporting up to 16 I/O modules. Power supply shall be DIN mounted, fused, rated for

120/220 VAC. Controller shall be Allen Bradley CompactLogix series as manufactured by Rockwell Automation. A separate industrial grade process computer shall be provided to offload high level functions from the main PLC. Process computer shall be DIN mounted and shall include LED indicators, Ethernet ports, RS232 ports, 12-48 VDC power input connection, and USB 2.0 host A type connector.

2.20.9 Discrete I/O cards shall be 16 channel and analog I/O cards shall include 8 channels. All wiring to modules will terminate on terminal strip. Individual lamps for each input or output shall be provided on each card. A minimum of 10% spare I/O shall be provided.

2.20.10 Operator Interface. C-More / AB PV Option Operator interface (OIT) shall be minimum 10" viewable TFT color touchscreen with 10MB minimum of user memory. The OIT shall be able to display 64K colors in VGA screen resolution (640x480) minimum. OIT's rated for less than NEMA 4/4X (indoor) or with a backlight half-life of less than 50,000 hours are not acceptable. Backlight must be user replaceable. The operating temperature shall be 0-50 degrees C and the power consumption shall not exceed 17W at 24VDC. The OIT shall have a built-in Ethernet port, shall support Ethernet or USB connection for programming software and shall be able to utilize Ethernet or serial communication to the PLC. The Ethernet port shall also be able to be utilized for advanced features such as email, web serving, FTP access and remote access as supplied. OIT's that required additional software or hardware for these features must be provided configured to support this. USB connection for external USB drive and Optional CF card shall be supported for data logging.

2.20.11 Hand-Off-Auto (HOA) switches for rotating equipment and Open-Auto-Close (AOC) switches for valves shall be provided on the panel front to allow for manual control of equipment. LED indicating lights shall be provided to indicate status of equipment. Overload and seal fail indication for submersible equipment shall be provided.

2.20.12 Wiring. All wiring to module will terminate on terminal strip. Panel wiring shall be:

- Type MTW, sized per applicable codes.
- 16 gauge minimum wire size for 120 VAC.
- 20 gauge minimum wire size for 24 VDC.

Wiring shall be color coded as follows:

- 120 VAC (unswitched).....black
- Neutral.....white
- Ground.....green
- +24 V.D.C. .....red
- 24 V (return) .....blue
- 120 VAC (switched)……yellow
- Dry Contact (remote power)……orange

2.20.13 PC Based Operator Interface. The existing personal computer shall be modified to run the operator interface software. The graphics software shall be reconfigured to represent the various process equipment and control loops and allow access to the operator adjustable setpoints. Data collection and limited report generation shall be included.

2.20.14 The operating software used to control the SBR shall utilize constant level measurement analysis totalized from the two (2) influent Parshall flumes to determine rate of influent flows and adjust

treatment steps dynamically. The control system software shall measure rise rate in the SBR to determine flow rate as a percentage of normal design flow based on an operator adjustable flow averaging period. The process computer software shall be programmed to automatically adjust treatment steps and overall treatment cycle length to optimize treatment performance at all flow ranges between minimum and maximum flow conditions. Adjustments to treatment steps shall be dynamic and not limited to pre-programmed "storm modes" designated to make stepped adjustments at designated peaking thresholds. The software shall also include provisions to automatically reconfigure tank set points when a tank is taken off line, allowing an operator to simply switch a tank from automatic to manual without the need to manually enter new set points for the remaining tanks. The software shall be capable of controlling up to 8 SBR tanks operating in sequence.

2.20.15 The SBR control software shall include a first response initiative which will automatically remove a tank from service in the event of a critical equipment failure. Selection of critical equipment shall be operator adjustable on a tank by tank basis. First response shall be initiated 5 minutes following the critical equipment failure to allow the operator time to respond. The software shall automatically re-adjust cycle structures in the remaining tanks in the event a tank is automatically taken offline. The first response software feature shall be capable of being enabled / disabled by the operator. Software shall also include a provision to automatically initiate corrective action in the event the emergency top water level float switch is tripped indicating a potential failure of the level transmitter.

2.20.16 Control Relays: Control relays, if required, shall be in accordance with the following requirements:

- Control relays shall be enclosed rated for 10 amps at 277 V AC, 80% PF.
- Relays shall include an LED to indicate when coil is energized.
- Expected life 10 million operations, mechanical; 100,000 operations minimum at rated loads.
- Temperature range -45º C to 55º C.
- Coil voltage 120 V, 60 Hz, unless otherwise specified.

2.20.17 Switches/Pilot lights

Selector switches shall be used on all automatic controlled equipment. Selector switches shall include contacts rated at 60 amps make, 6 amp break, 10 amp continuous. Pilot lights shall be LED, push-to-test type. All switches and lights shall be clearly labeled with white plastic legend plates with black lettering.

2.20.18 A remote access modem shall be provided to permit remote monitoring of the process and alarm conditions via the internet.

2.21 Autodialer

The existing automatic dialing remote monitoring system shall be modified to incorporate the new process alarms. When an alarm condition occurs, the autodialer automatically dial preprogrammed telephone numbers and report the station identification and specific alarm condition that exists. Calls may also be made directly to the unit at any time from any telephone for a complete status report. Front panel LED indicators shall show system operation, alarm status, battery condition, and provide system operation information at the site.

2.22 Software

The PLC function shall be to control, sequence, and monitor the complete SBR system including the four (4) SBR aeration basins, two (2) post-equalization basin, four (4) digesters, and two (2)

sludge holding Basin to include:

2.22.1 Regulation of the process cycles of the SBR system up to the maximum daily flow of the plant including the decant cycle operation of the aeration basins and status of the four (4) digester.

2.22.2 Regulation of the aeration and mixing systems to achieve optimum process control.

2.21.3 Component Monitoring, the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

2.22.3 SCADA Monitoring System
The existing SCADA monitoring system shall be modified to incorporate the alarm and monitoring information for the complete integrated system.

## 3 EXECUTION

3.1 Handling

3.1.1 All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times.

3.1.2 Equipment damaged by the weather, handling or construction shall be immediately repaired or replaced to the Engineer's satisfaction.

3.2 Installation
The installation of the equipment furnished by the supplier/manufacturer shall be the responsibility of the CONTRACTOR in accordance with the contract document. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings. All anchor bolts, piping, valves and appurtenances required for a complete installation shall be provided.

3.3 Service

3.3.1.1 Equipment manufacturer shall furnish all instruction and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, place the equipment in permanent operation, instruct the Owner's personnel in operation and maintenance, and perform field tests to insure proper operation. A minimum of four (4) trips and fourteen (14) eight (8) hour days at the jobsite shall be included for this service. A report of the field test results shall be provided and included in the final service manual. The report as a minimum shall contain performance information pertaining to pump shut-off head, pumping head and flow rate and voltage readings at the designated flow rate and head. If there are difficulties in the operation of the equipment, additional service shall be provided at no cost to the OWNER.

3.4 Warranties
The process equipment supplier will warranty all supplied equipment, for a period of one (1) year. The warranty period shall include the twelve (12) month period beginning upon the date of acceptance of the equipment by the OWNER.

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SECTION 44 46 16
ROTARY SLUDGE PRESS EQUIPMENT AND CONVEYORS (RSP-3 & RSP-4)

PART 1 GENERAL

1.1 SUMMARY

A. The contractor shall furnish all labor, materials, equipment, supplies, fittings and appurtenances required for the fabrication, installation and startup of a rotary press sludge dewatering systems and accessories as shown on the plans and specified herein.

1. General Description

a. The rotary press sludge dewatering system shall consist of two (2) sludge flocculators, two (2) rotary presses with feed manifolds, dewatered sludge receiving conveyors, one (1) inclined conveyor, one (1) overhead distributing conveyor, instrumentation and controls. The system shall be a complete operating installation allowing simultaneous operation of the units to receive liquid aerobic digested wastewater sludge and liquid polymer. The sludge and polymer shall then be properly conditioned, dewatered and conveyed by screw conveyors to either of two (2) waste sludge dumpsters.

b. The rotary press shall consist of six (6), 36-inch diameter dewatering channels based upon the following design conditions:

- Sludge Materials - Aerobic digested sludge from domestic wastewater treatment operations utilizing a sequencing batch reactor process.
- Sludge Feed Rate - 40 to 80 gpm per unit
- Sludge Feed Pressure- 7 psi or less
- Sludge Feed Solids 1.5 to 2.5% solids
- Final Sludge Cake 18 to 24% solids
- Polymer 10 to 20 lbs/dry ton
- Solids Capacity 85-100 dry lbs/channel - hr
- Solids Capture Rate 95% (minimum)
- Wash Water 50 gpm @ 30 - 100 psi

1.2 PERFORMANCE REQUIREMENTS

A. The manufacturer shall provide a written performance guarantee that the rotary press system shall provide a minimum final sludge cake consistency of greater or equal to 15% solids with a minimum solids capture of 90% and maximum polymer usage less than 20 lbs (active polymer)/dry ton and capable of compliance with the "Paint Filter Test" as described in EPA Publication SW-486 Method 9095.

1.3 RELATED WORK

A. See the following specifications for related work:

1. Section 01 33 01 - Submittal Procedures EPMS
2. Section 01 43 13 - References

3. Section 01 70 00 - Execution and Closeout Procedures
4. Section 43 21 36 - Rotary Lobe Pumps
5. Section 46 33 33 - Polymer Blending & Feeding Equipment
6. Division 26 - Electrical

## 1.4 QUALIFICATIONS

A. Manufacturer: No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of municipal wastewater sludge dewatering equipment. To demonstrate the Bidder's qualifications to furnish the Rotary Press and ancillary equipment, the Bidder shall submit written evidence within five (5) days of the Owner's request, that their firm has been regularly engaged in the design, fabrication, testing, start-up and service of full scale Rotary Presses for a period of not less than seven (7) years and has no fewer than seven (7) installations on similarly-sized municipal wastewater treatment facilities that have been in operation for at least five (5) years. Multiple equipment units for one (1) project site will be considered as one (1) installation toward meeting the experience requirements. Installations shall be only those in the United States (fifty states). The installation list shall include but not be limited to the following information:

1. Name and location of installation
2. Name of person in direct responsible charge for the equipment
3. Address and phone number of person in direct responsible charge
4. Month and year the equipment was placed in operation
5. Brief description of equipment

# PART 2 PRODUCTS

## 2.1 ROTARY PRESS (RSP-3 & RSP-4)

A. Drive System:

1. The dewatering channel of each Rotary Press will be mounted on the gear reducer output shaft.
2. Speed Reducer –
   a. The speed reducer will be a foot mounted type with spiral bevel and helical gears fabricated according to ANSI/AGMA 6010 standard. Bevel gears will have a minimum of AGMA quality of 9 and the helical gears a minimum of AGMA 10.
   b. Output shaft will be made of steel with a minimum yield of 59000 PSI and minimum diameter of 6-3/16".
   c. The speed reducer will be mounted on an epoxy painted steel base.
   d. No parts of the speed reducer, including gearbox seals will be in direct contact with either the sludge, filtrate or cake. The output seal will be an integral part of the speed reducer housing; there will be no bolt-on output cover to cause leakage, shaft or gear misalignment.
3. Motor –
   a. The electrical motor shall be directly coupled to the speed reducer and shall be sized for the six (6) channels.

b. The motor shall be 480 volt, 60 Hz, 3 PH, 1800 RPM, totally enclosed and ventilated, 20 HP (minimum), "C" frame, high efficiency, service factor 1.15, insulation "F" class, design "B".

B. Dewatering Channels:

1. The dewatering channel of the Rotary Press will be mounted on the gear reducer output shaft. Each channel will be an independent self-contained modular unit which can be interchanged with other Rotary Presses of the same model.
2. The low-speed shaft seal of the speed reducer will, in no way, act as a filtrate seal for the dewatering channel.
3. All material in direct contact with the flocculate sludge or with the cake will be in stainless steel or plastic made.
4. Each channel will be numbered with a plastic laminated plate.
5. Except for filtration elements, the channel will be made of painted carbon steel. Filtration elements shall be made of stainless steel and chrome plated for wear resistance.
6. Filtration wheels shall be made of cast iron ASTM A48 Class 40.
7. Deflector shall be fabricated from a molybdenum disulphide-filled nylon (Nylatron).
8. The gland covers will be made from 1/4" thick minimum fiberglass with a minimum of 3 to 6 layers depending on the cover section. This cover will be used to compress the UHMW gland cover seal between the housing and filtration wheel. The cover will have an outlet in it lower section to drain the filtrate.
9. An additional opening is made for the outside wheel wash water system connection and air bleeding device. For inspection or maintenance, an opening port is located at the rear portion of the cover to permit easy access.
10. Two (2) UHMW bushings will guide the gland cover on the filtration wheel. Sealing will be assured by three (3) "O-rings", two (2) between bushings and the filtration wheel, and one (1) between the gland cover and the housing.
11. Gland covers shall be identical and shall act as gland to maintain the seal in proper position.
12. The gland cover shall also include in the lower part piping outlet to drain filtrate. Channel bearings shall be made of oil lubricated cast nylon shall be sealed using two (2) O'rings. For maintenance purpose, each gland cover will be equipped with three (3) lifting ears equally spaced.

C. Housing:

1. Each housing shall be made from 5/8” thick steel plate. The surface in direct contact with the cake will be stainless steel lined.
2. The housing shall be supported by the filtration wheel through a set of bushing. Rotating of the housing is restricted by a torque arm, connecting the channel housing to the gear reducer base support.
3. Each housing shall be interchangeable with other Rotary Presses of the same series.

D. Wash system

1. A wash system shall be provided for daily cleaning of the inside of the channel(s) and the outside of the filtration wheel(s).
2. One (1) wash manifold shall be located inside the channel at the sludge inlet. This manifold shall be made of a stainless steel tubing assembly and mounted with twenty-eight (28) flush type stainless steel sprinklers.

3. One (1) set of two (2) manifolds for each filtration wheel shall consist of four (4) sprinklers located in between the filtration wheels and the gland covers. Each manifold shall be made of stainless steel fittings and brass flat jet sprinklers.
4. For maintenance purpose, the manifold assembly shall be assembled to a mounting plate bolted and sealed to the gland cover. All sets of nozzles shall detach from the water supply using a quick disconnect system for easier maintenance.
5. The wash system shall come equipped with a one way check valve to prevent the back flow of sludge into the wash system.

E. Filtrate Collection

1. Each channel shall be equipped with a removable filtrate collector made of low linear density polyethylene (LLDPE) and terminating in a 6" diameter PVC, Sch. 80 outlet connection manifold.
2. Each filtrate collector shall be piped to a manifold made with Sch. 40, 6" dia. (152.4 mm) PVC piping and ending with a 6" tee.
3. Each filtrate collector will include two (2) sampling ports to sample filtrate. Sampling port will be closed by a removable plug.

F. Rotary Press Base

1. The base shall be fabricated from bend 3/8" thick steel plate. Base will be a close shape to optimize rigidity and spread the load evenly to the supporting floor. Anti-rotation device fixations are integrated to the base to facilitate the installation.

G. Cake Outlet Chutes

1. Every cake outlet shall have a chute with an inspection door mounted on hinges and kept closed with "quick ties".
2. The chute shall be made in low linear density polyethylene (LLDPE) and include a hole for mounting a cake sensor.

## 2.2 FLOCCULATOR AND FEED MANIFOLDS

A. Flocculators (PF-601 & PF-602)

1. The flocculators shall be designed with a minimum tank capacity of seventeen (17) gallons and for 100 PSI pressure and a maximum temperature of 140°F. The body and bolted cover shall be fabricated of painted carbon steel with a minimum thickness of 3/8". The flocculator inlet manifold shall be made of stainless steel.
2. The agitators shall be variable speed and driven by a gear motor with a helical type, hollow shaft. The hollow shaft shall be 1 3/16" diameter, 4:03 to 1 ratio. The motor shall be a 1 HP, 1750 RPM, 480 volt, 3 PH, 60 Hz, continuous duty, Class F, approved CSA.
3. The seal at the agitator shaft and the flocculator wall shall consist of two (2) lip seal contacts with grease cavity in between. A grease fitting shall allow the cavity to be lubricated.
4. Flocculator connections shall include the following:
    a. Sludge inlet - 3-inch Victaulic grove (type 77)
    b. Sludge outlet - 3-inch NPT
    c. Pressure sensor fitting (Ref.: Press inlet pressure)
    d. Wash water connection - 1-1/2-inch NPT
    e. Polymer connection - 1-1/2-inch NPT

f. Air purge

5. Threaded connections for service and instrumentation shall be located on the inlet manifold of the flocculator.
6. Each flocculator shall be equipped with a PVC air breather located at the top of the flocculator and connected to a water line for occasional back wash and to the drain line to collect any sludge leak.

B. Feed Manifolds

a. The piping between each flocculator and the rotary press shall be made of schedule 10, 316 stainless steel.
b. The feed manifold and other accessories will be tested in the shop at 100 PSI hydrostatic pressure.
c. Pipe fittings shall be Victaulic type as described below:
   1) On the lines less than 10 feet long: Style 77 Victaulic joints.
   2) On the lines more than 10 feet long: Style 07 "Zero Flex" Victaulic joints.
   3) On the vertical lines: Style 77 Victaulic joints.
   4) Flange-to-flange joints: Style 741 "Vic-flange".
   5) Butt joint coupling: Victaulic style 99 "Roust-A-Bout".

## 2.3 VALVES AND ACCESSORIES

A. Sludge Feeding and Recirculation Valves

1. Two (2) pneumatically-actuated valves will be installed on each sludge line between the rotary press and the flocculator. These feed and recirculation valves will be two-way ball valve type.

| | | |
|---|---|---|
| a. | Size diameter: | 3 inches dia. |
| b. | End connection: | ANSI 125# Flanged |
| c. | Body material and facing: | Painted cast iron |
| d. | Ball: | Ductile iron / Teflon fuse ball |
| e. | Shaft: | Stainless steel |
| f. | Seat type: | RPTFE |
| g. | Valve manufacturer: | Quality Certified Valve, American Valve, Sure Flow or equivalent. |
| h. | Actuator: | Pneumatic double acting<br>2-pistons design on geared shaft<br>Nominal torque at 81 PSI: 2390 lbs in<br>FESTO or equivalent. |
| i. | Position indicator: | IP67<br>Visual indicator of position<br>SPDT limit switches<br>Watertight<br>FESTO or equivalent |
| j. | Solenoid valve: | 24 VDC, five ways,<br>IP65<br>Anodized aluminum body<br>Manual override<br>FESTO or equivalent. |

B. Isolation and Process valve

1. All valve(s) will be compatible with the nominal operating pressures of the different systems and will be designed to resist the operating temperatures and the contained fluids. The valves will be of equal diameter as the piping except where indicated otherwise.
2. At the inlet of each channel, a shut-off valve will be supplied. The valve will be ball type with the following characteristics:
    a. Valve type: Full port
    b. Nominal size: 76.2 mm (3“)
    c. Body material: Painted cast iron
    d. End connection: ANSI 150# flanged
    e. Ball material: Ductile iron / Teflon fused
    f. Seat: RPTFE
    g. Actuator: Lever
    h. Manufacturer: Quality Certified Valve, American Valve, Sure Flow or equivalent.
3. All other valves other than the one above will be ball valve, type full port, SS316 body, PTFE seat. Acceptable manufacturers are Quality Certified Valve, American Valve, C.F.F., Trueline, H&P or equivalent.

C. Wash Water Valves
1. For automatic control purposes, a pneumatic actuator with a 5 way solenoid valve will be installed to control the wash water valve to each individual channel.
2. The wash water valve will be ball type and full port. The process connection will be 1" NPT. Maximum valve pressure will be 1000 PSI and the body will be made of 316 stainless steel.
3. The pneumatic actuator will be spring return type. The body will be made of aluminum anodized.
4. The solenoid valve will have 5 ports and 2 positions. The valve body will be made of anodized die cast aluminum and will have an insulation rating of IP65. The working pressure will be in the range of 36 PSI to 116 PSI. The port connection will be G1/4. Valve electrical supply will be 24VDC with a power of 2.4W and the connection will be DIN type. The solenoid valve shall also be controlled by a manual override.

D. Polymer Check Valves
1. A stainless-steel check valve shall be installed on the polymer line to prevent sludge from entering the polymer feed line.
2. The check valve shall start to open at 0.5 psig and be fully opened at 1.0 psig.
3. The valve will be spring assisted for silent closing and minimizing the effect of water hammer. The valve temperature limit will be 20 °F to 400 °F.

E. Flocculated Sludge Samplers
1. A flocculated sludge sampler will be supplied. The device will consist of a transparent PVC tube to inspect the texture of the flocculated sludge. A vent and a sludge inlet valve will allow filling and draining the sampler without dismantling or adding any pipes, tubes or plugs. The sampler is easily removable for maintenance.
    a. 2” stainless steel isolating valves will be installed to isolate, drain or sample sludge;
    b. 3/4” wash and vent stainless steel valves will be supplied.

F. Wash Water Pressure Gauges and Switches

1. A pressure gauge shall be installed at each flocculator on the wash water line. The pressure gauge will be a 2-1/2", liquid filled. The scale will be 0 to 160 PSI.
2. A pressure switch shall be installed in order to transmit a signal of low pressure water washing. The pressure switch shall be 1/4" NPT, SPST (normally close). Range 30 to 120 PSI. The switch will be calibrated to 60 PSI.

## 2.4 ROTARY PRESS INSTRUMENTS AND CONTROLS

A. Basic principle of operation

1. The dewatering system shall consist of two (2) rotary presses and flocculators, along with control devices necessary to maintain an adequate proportion of flow and pressure, resulting in a uniform feed of sludge and diluted polymer to each press. Each rotary press shall include a receiving conveyor to transfer dewatered sludge to a single inclined conveyor for conveying the sludge to the center section of an overhead distribution conveyor for transfer into either of two (2) dumpsters by changing the direction of the conveyor.
2. The feed sludge is pumped to the flocculator to maintain a constant pressure at its inlet. To accomplish this, the rotating speed of the feed sludge pump will be adjusted according to the internal pressure of the flocculator to maintain the pressure close to the set value.
3. The diluted polymer is pumped to the flocculator to obtain a specified polymer-sludge dosage. The dosage is controlled by adjusting the speed of the diluted-polymer pump and is a function of the speed of the sludge pump, and a set value entered by the operator. From the flocculator, the flocculated sludge is fed into each of the channels of the rotary press.
4. The channel outlet pressure is controlled by modulating a restrictor device at the cake outlet. The applied air pressure of the restrictor's actuator is controlled to maintain a constant outlet pressure.

B. Instrumentation

1. Sludge Flow Meters - Sludge flowmeters shall be installed at each flocculator inlet and have the following specifications:

| | | |
|---|---|---|
| a. | Type | Electromagnetic |
| b. | Measured error | ±0,5% |
| c. | Diameter/measuring range | 2" -10-300 gpm/3" - 24-800 gpm |
| d. | Process temperature | -4 °F to 176 °F (-20 °C to 80 °C) |
| e. | Electrical connection | 1/2"NPT |
| f. | Process connection | Flange type |
| g. | Display/operation | Two line display with backlit / push button |
| h. | Output signal | 4-20mA |
| i. | CSA/FM approval class | Class 1 Division 2 |
| j. | Liner material | Polyurethan |
| k. | Electrode material | 316L SS |
| l. | Protection | IP67/Nema 4X |
| m. | Company | Endress & Hauser |
| n. | Series | 50W |
| o. | Power Supply | 120 VAC |

2. Polymer Flow Meters - A polymer flowmeter shall be installed at each flocculator inlet and have the following specifications:

| | | |
|---|---|---|
| a. | Type | Electromagnetic |
| b. | Measured error | ±0,5% |
| c. | Diameter/measuring range | 1/2" -1-27 gpm/1" - 2,5-80 gpm |
| d. | Process temperature | -40 °F to 356 °F (-40 °C to 180 °C) |
| e. | Electrical connection | 1/2"NPT |
| f. | Process connection | Flange type |
| g. | Display/operation | Two line display with backlit / push button |
| h. | Output signal | 4-20mA |
| i. | CSA/FM approval class | Class 1 division 2 |
| j. | Liner material | PTFE |
| k. | Electrode material | 316L SS |
| l. | Protection | IP67/Nema 4X |
| m. | Company | Endress & Hauser |
| n. | Series | 50P |
| o. | Power Supply | 120 VAC |

3. Inlet Pressure Gauge and Pressures Transducers - The inlet pressure gauge and transducer shall be installed at each flocculator inlet and have the following specifications:

| | | |
|---|---|---|
| a. | Type: | Digital pressure transducer, capacitive, ceramic |
| b. | Typical linear: | +/- 0.075 % |
| c. | Operating pressure range: | 0-30 PSI |
| d. | Proof pressure (without any damage to the transducer): | 270 PSI |
| e. | Electrical connection: | 1/2" NPT |
| f. | Calibration: | Between 0 and 30 PSI |
| g. | Output: | 4-20 mA, with Hart Communication; Inside + LCD |
| h. | Process connection: | 1/2" NPT/M |
| i. | FM Approbation, Classes: | 1, 11, 111 Division 1 |
| j. | Diaphragm material: | Ceramic |
| k. | Company: | Endress & Hauser |

4. Outlet pressure control
   a. Cake outlet pressure shall be controlled by air pressure on the bellows actuating the vertical restrictor.
   b. An adjustable airline pressure regulator shall be used to control the outlet pressure. Each channel shall have its own in line air regulator. Regulators shall be relieving type with a pressure range of 2 to 125 PSIG, 1/4 inch port, with 125 PSIG pressure gage.
   c. For automation purposes, a single electro-pneumatic transducer will be included in the control system.
5. Cake sensing
   a. Each channel will have a cake sensor mounted on the outlet chute cover. For easy maintenance, the sensor will be equipped with a quick connector.
6. Wash water pressure switch
   a. A pressure switch shall be installed on the wash water line at the flocculator. The pressure switch will be 1/4" NPT, SPST/NO. The switch shall cover an adjustable range of 30 to 120 PSI.

b. The switch shall be shop calibrated at 60 PSI and sealed. The dry contact of the switch will be used to produce a low pressure alarm on the operator interface.

C. Process Control Cabinets

1. Prewired Control Cabinet - A local control cabinet shall be NEMA 4, steel painted enclosure and shall operate on 480 volt, 60 Hz, 3 phase power supply. The enclosure shall include the following:
   a. Back-panel mounted components and devices consisting of (but not limited to) the following:
      1) Main fused disconnect switch
      2) Circuit breakers for PLC, HMI and others control devices
      3) Variable frequency drive (VFD)
      4) Programmable logic controller (PLC)
      5) DC power supply
      6) Relay
      7) Safety relay
      8) LAN modem (Internet communication)
   b. Door mounted components consisting of (but not limited to) the following:
      1) Power warning alert indicator
      2) Operating handle for main fused disconnect switch
      3) Emergency stop push button
      4) Human machine interface (HMI)
2. Programmable Logic Controllers (PLC) – Two (2) programmable logic controllers (PLC's) shall be used to control the rotary presses and the related equipment. Each PLC shall have Ethernet/IP communication to communicate with the HMI and the plant network. PLC shall be:
   a. Allen-Bradley CompactLogix Serie L30.
   b. The PLC's will require the following signal types:
      1) Analog inputs: 4-20 mA
      2) Analog outputs: 4-20 mA
      3) Discrete inputs: 120 VDC
      4) Discrete output: Dry contact
3. Human machine interface (HMI) - A human machine interface will be used to operate the rotary presses and the related equipment. HMI shall have a built-in Ethernet communication port to communicate with the PLC and USB port. HMI shall be TFT touch panel with 65K color, NEMA 4/4X, IP65 and shall be:
   a. Model GP-4301TM, Pro-face
   b. Built-in Ethernet & USB
   c. Color TFT touch panel
   d. 5.7 inch (14,5 cm) Viewable screen, 65K colors
   e. 320 x 240 pixels QVGA screen resolution
   f. 24 VDC
   g. NEMA 4X, IP65
4. Variable frequency drives (VFD) - Variable frequency drive shall be used to control the speed of the rotary press and the flocculator. VFD shall have overload protection and ramp regulation capability. Configuration and programming shall be done via a keypad. Run command will be with dry contact and the speed shall be with 4-20 mA. VFDs shall be powered with 480 VAC, 3-phases, 60Hz. Output will

be 480 VAC, 0-60Hz. VFD rating 5 HP and shall will be flange mounted type, in order to keep the heat outside the control cabinet. VFD's shall be the following:

a. Rotary press
   1) Qty: One (1) for each rotary press motor
   2) Power: As per motor requirement
   3) Company: Allen-Bradley
   4) Model: Powerflex 70

b. Flocculator
   1) Qty: One (1) for each flocculator motor
   2) Power: 1 HP
   3) Company: Allen-Bradley
   4) Model: Powerflex 40

5. Rotary press junction box –
   a. A pre-wired NEMA 4X FRP enclosure junction box shall be installed on the rear of the rotary press gearbox.
   b. Wash valves and cake detection sensor shall be routed to this junction box and connected to terminal blocks.
   c. The Rotary press junction box will have the following equipment:
      1) I/P converter
      2) Air filter and regulator
   d. To insure proper air quality and inlet pressure control to system, an air regulator and an air filter are to be furnished and installed on the air inlet supply of the Rotary press junction cabinet. The air regulator and air filter will be rated for air purity class 3.7 per DIN ISO 8573-1, high efficiency general purpose protection for a particle removal down to 5 microns, including water and oil aerosols. 1/4" NPT type connection, fully automated drain, maximum pressure 175 PSI, operating temperature between 35 °F & 140 °F, an integrated air regulator shall include a manometer, range 0-175 PSI with lockable rotary knob Model # MS4N-LFR-1/4-D7-CRV-AS from Festo or equivalent.
6. Emergency stop push button - An emergency stop push button will be installed in front of the rotary press and wired to the junction box

D. Programming
1. Process parameters and control will be accessible to the pre-program PLC via operator interface. The operator will have access to the following:
   a. Sludge Feed Pumps, P-20 or P-21 (Specification Section 44 46 16)
   b. Polymer Feed Pump (P-22)
   c. Outlet pressure control
   d. Sludge inlet pressure via PID control
   e. Polymer/Sludge ratio
   f. Rotary press rotating speed
   g. Flocculator agitator speed
   h. Manual control of each equipment
2. Programming shall include the following protection/alarm:
   a. High inlet pressure, stop the dewatering system
   b. Zero flow on sludge input flow, stop the dewatering system
   c. Cake flush, stop the dewatering system
   d. Preventive maintenance notice, alarm only

e. Low wash water, alarm only
f. Low air pressure, stop the dewatering system
g. Any motor did not start, stop the dewatering system

3. Programming shall include the following minimum alarms:
   a. Rotary press faulted
   b. Rotary press did not start
   c. Flocculator faulted
   d. Flocculator did not start
   e. Sludge pump faulted
   f. Sludge pump did not start
   g. Sludge pump low flow
   h. Polymer pump faulted
   i. Polymer pump did not start
   j. High inlet pressure
   k. Cake flush
   l. Low air pressure
   m. Low wash water pressure
   n. Preventive maintenance warning
4. The operator interface shall be built to give friendly usage to the operator with the following screen page available to the operator:
   a. Menu page
   b. Cycle start-stop page
   c. Parameter page
   d. Loop display page
   e. Sludge pump control loop page
   f. Rotary press manual operation page
   g. Preventive maintenance advise page
5. The following output signals shall be provided as output to the plant SCADA system:
   a. Rotary Press operation status
   b. Rotary Press fault alarm
   c. Flocculator start failure
   d. Flocculator fault alarm
   e. Polymer Feed Pump P-22 operation status
   f. Polymer Feed Pump P-22 start failure
   g. Sludge Pump P-21 operation status
   h. Sludge Pump P-21 start failure
   i. Sludge Pump P-22 operation status
   j. Sludge Pump P-22 start failure
   k. Polymer feed line high pressure
   l. Polymer feed line low pressure
   m. Sludge feed line high pressure
   n. Sludge feed line low pressure
   o. Receiving conveyor start failure
   p. Receiving conveyor overload
   q. Inclined conveyor start failure
   r. Inclined conveyor overload
   s. Distribution conveyor start failure

t. Distribution conveyor overload
u. Low pneumatic air supply pressure
v. Flush detection

## 2.5 SLUDGE CONVEYORS

A. Conveying equipment shall consist of a receiving conveyor for each rotary sludge press, connected to an inclined conveyor and a distribution conveyor for transfer dewatered sludge from the rotary press dewatering channels to either of the OWNER's two (2) waste sludge dumpsters. Conveyors shall be as shown on the CONTRACT DRAWINGS and coordinated by the supplier of the rotary press equipment to meet the below requirements.

1. Receiving Conveyors (C-601 & C-602):
   - a. Type of conveyor — Hollow Flight
   - b. Material handle — Cake from rotary press
   - c. Material density — 45 lb/cu. Ft
   - d. Conveyor slope — 0 deg.
   - e. Flight diameter — 10 inches
   - f. Length — Per CONTRACT DRAWINGS
   - g. Gear Reducer:
     - 1) Type — Hollow shaft, 26 RPM
     - 2) Motor — 2 HP, 1800 RPM, 460 Volts, 60 Hz (minimum)
   - h. Shaft seal — Shaft lip seal to prevent sludge entry to the gear box w/ spacer plate to prevent sludge to build pressure on shaft seal
   - i. Material:
     - 1) Trough - Stainless Steel AISI-304, mill finish, flanged type, thickness1/8-inch (minimum)
     - 2) Liner - 3/8" UHMW (minimum)
   - j. Flight dimensions - 3/4" thick x 2-1/2" high
   - k. Flanged trough - Flange thickness 3/8"
   - l. Support legs - 5/16" thick
   - m. Cover - Stainless Steel AISI-304, mill finish 12 ga. bolted, 4 ft maximum length.
   - n. Inlet - Four (4) 16 ga. Stainless Steel inlet cake chutes matching with the rotary press
   - o. Supports - Per CONTRACT DRAWINGS
2. Inclined Conveyor (C-603)
   - a. Type of conveyor — Hollow flight
   - b. Material handle — Cake from rotary press receiving conveyors
   - c. Material density — 45 lb/cu. ft
   - d. Conveyor slope — 30 degrees (approximate)
   - e. Flight diameter — 12 inches
   - f. Length — Per CONTRACT DRAWINGS
   - g. Gear Reducer:
     - 1) Type — Hollow shaft, 26 RPM
     - 2) Motor — 2 HP, 1800 RPM, 460 Volts, 60 Hz (minimum)
   - h. Shaft seal — Shaft lip seal to prevent sludge entry to the gear box w/ spacer plate to prevent sludge to build pressure on shaft seal

| | | |
|---|---|---|
| i. | Material: | |
| | 1) Trough | Stainless Steel AISI-304, mill finish, thickness – Sch 40 by sections 48” long, flanged type |
| | 2) Liner | 3/8" UHMW (minimum) |
| j. | Flight dimensions | 3/4" thick x 2-1/2" high |
| k. | Flanged trough | Flange thickness 3/8" |
| l. | Support legs | 5/16" thick |
| m. | Cover | Stainless Steel AISI-304, mill finish 12 ga. bolted, 4 ft maximum length |
| n. | Inlet: | One (1) side inlet from receiving conveyor |
| o. | Outlet: | Free vertical discharge to dumpster below |
| p. | Supports | Per CONTRACT DRAWINGS |

3. Distributing Conveyor (C-604) –

| | | |
|---|---|---|
| a. | Type of conveyor - | Hollow flight |
| b. | Material handle - | Cake from rotary press inclined conveyor |
| c. | Material density - | 45 lb/cu. ft |
| d. | Conveyor slope - | 0 degrees |
| e. | Flight diameter - | 12 inches |
| f. | Length - | Per CONTRACT DRAWINGS |
| g. | Gear Reducer: | |
| | 1) Type | Hollow shaft, 26 RPM |
| | 2) Motor | 2 HP, 1800 RPM, 460 Volts, 60 Hz (minimum) |
| h. | Shaft seal - | Shaft lip seal to prevent sludge entry to the gear box with opened spacer plate to prevent sludge building pressure on shaft seal |
| i. | Material: | |
| | 1) Trough | Stainless Steel AISI-304, mill finish, Thickness - 1/8" |
| | 2) Liner | 3/8" UHMW (minimum) |
| j. | Flight dimensions - | 3/4" thick x 2-1/2" high |
| k. | Flanged trough - | Flange thickness 3/8" |
| l. | Support legs - | 5/16" thick |
| m. | Cover - | Stainless Steel AISI-304, mill finish 12 ga. bolted, 4 ft maximum length |
| n. | Outlets - | Six (6) outlets, including four (4) outlets with motorized sliding gate. Inner surface of gate to be lined with UHMW and to be parallel and adjacent to the bottom of screw conveyor. Motorization will be performed with a pneumatic cylinder with pneumatic valve to be mounted on the cylinder. |
| o. | Outlet drop chutes - | Each conveyor outlet (6 total) is to include a flexible drop chute for conveyance of material to the dumpster to minimize splatter. |
| p. | Supports | Per CONTRACT DRAWINGS |

B. Conveyor Instrumentation - Each of the conveyors shall include one (1) zero speed switch to detect the flight rotation. Zero speed switch is to be a magnetic proximity sensor. The switch will consist of a ultrasonic sensor. The speed count shall be controlled by the dewatering system PLC.

## PART 3 HANDLING AND INSTALLATION

### 3.1 HANDLING

A. All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from the weather at all times. Equipment damaged by the weather, handling or construction shall be immediately repaired or replaced to the ENGINEER's satisfaction.

### 3.2 INSTALLATION

A. Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings.

### 3.3 FIELD TESTS

A. Following the completion of installation, a qualified representative of the equipment manufacturer shall inspect the complete installation, instruct the OWNER's personnel in operation and maintenance and perform field tests to insure proper operation. A field test report and written certification to the OWNER and ENGINEER shall be provided that equipment and controls have been installed and operate in accordance with the specifications and drawings and that the operation and maintenance instructions have been furnished to the ENGINEER. The manufacturer shall include within the bid, as a minimum, the services of a qualified field service for a minimum period of five (5) days in two trips, excluding travel. Additional service necessary due to improper erection or other startup problems shall be provided as necessary at no additional cost to the OWNER until the system is properly operating and accepted by the OWNER.

### 3.4 OWNER'S FINAL ACCEPTANCE OF EQUIPMENT

A. Final acceptance of the equipment by the Owner will not be provided until the equipment satisfactorily complies with the performance requirements on daily composite final sludge sample. The performance shall be determined based on a minimum of three (3) tests over a three (3) operating days and:

1. Composite dewatered sludge sample consisting of a minimum three (3) grab samples taken from each channel over a minimum 3-hour operating period.
2. Minimum sludge feed rate of 90 dry lbs/channel-hr with the feed solids between 1.5% and 2% and a maximum polymer feed of 20 lbs/dry ton.
3. Minimum final cake solids yield > 15% solids.

## 3.5 CERTIFICATION

A. After installation and final testing of the equipment and instrumentation, the manufacturer furnishing supervision, inspection and startup service shall make a written certification to the OWNER that the equipment and controls have been properly installed and operate in accordance with the specifications and drawings.

## 3.6 WARRANTY

A. The overall equipment/system warranty shall be one year from successful start-up and acceptance by Owner or 18 months from shipment whichever is sooner. Wear parts as deflectors, scrapers and seals shall be guaranteed for two thousand five hundreds (2,500) hours of operation.

END OF SECTION

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SECTION 46 24 13
SLUDGE MACERATOR (SM-501)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Macerators, motors, and accessories.

B. Related Requirements:
1. Section 01 33 01 - Submittal Procedures EPMS
2. Section 01 70 00 - Execution and Closeout Procedures
3. Section 43 21 36 - Rotary Lobe Sludge Pumps
4. Section 46 71 33 - Rotary Drum Thickener

1.2 REFERENCE STANDARDS

A. American Iron and Steel Institute:
1. AISI 4130 – Heat Treated Alloy Steel
2. AISI 4140 – Heat Treated Hexagon Steel

B. ASTM International:
1. ASTM A536-84 – Standard Specification for Ferritic Ductile Iron Castings.
4. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

C. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 2 - Controllers, Contactors and Overload Relays Rated 600 V.
3. NEMA MG 1 - Motors and Generators.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with Work of other Sections.

1.4 SUBMITTALS

A. Section 01 22 01 – Electronic Project Management System and 01 33 01 – Submittal Procedures EPMS: Requirements for submittals.

B. Product Data: Submit manufacturer information for system materials and component equipment, including electrical characteristics and connection requirements.

C. Shop Drawings:
1. Indicate size and configuration of assembly, mountings, weights, and accessory connections.

2. Indicate system materials, component equipment, wiring diagrams, and schematics.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

G. Qualifications Statement:
1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Record actual locations of macerators.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:
1. The following spare parts shall be supplied with the unit:
   a. Three (3) fuses
   b. Three (3) 6-volt, long life lamps
   c. One (1) complete gasket set
   d. Three (3) cutters
   e. Three (3) spacers
2. Controller spare parts shall be stored inside the controller.
3. Grinder spare parts shall be packaged in containers suitable for long term storage and shall bear labels clearly designating contents and equipment for which they are intended.

C. Tools: Furnish special wrenches and other devices required for Owner to maintain and/or calibrate.

1.7 QUALITY ASSURANCE

A. The grinder and controller shall be installed in accordance with the supplier’s installation instructions and in compliance with all OSHA, local, state, and federal codes and regulations.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five (5) years' documented experience.

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept macerators on Site in manufacturer's original packaging and inspect for damage.

B. Store macerators according to manufacturer instructions.

C. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

## 1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish a minimum of one-year warranty from date of Owner acceptance of 18-month from shipment.

# PART 2 PRODUCTS

## 2.1 MACERATORS

A. Description:
   1. Self-cleaning.
   2. The main housing shall be a solid cast structure made of ASTM A 536-84 ductile iron. The one-piece flanged body shall be capable of remaining in-line if removal of the cutter cartridge and drive assembly is required for service.
   3. The inside profile of the main housing shall be concave to follow the radial arc of the cutters. To direct larger particles toward the cutters and assure fineness of grind, the main housing shall maintain a clearance not to exceed 5/16-inch (8-mm) between the major diameter of the cutter and the concave arc of the housing.
   4. The main housing shall be provided with a covered access port for equipment inspection. Inspection port covers shall be ASTM A 536-84 ductile iron.

B. Basis of Design: The basis of design and performance requirements for the sludge grinder shall be as follows:

| | | |
|---|---|---|
| 1. | Number of grinder units | 1 |
| 2. | Design flow rate | 600 gpm (maximum) |
| 3. | Pipeline flanged connections | 6 inch |
| 4. | Pressure drop | 1 psi (maximum) |
| 5. | Electrical service | 460 volt/3 phase/60 Hz |
| 6. | Motor horsepower | 3 Hp (minimum) |

C. Main Housing
   1. The main housing shall be a solid cast structure made of ASTM A 536-84 ductile iron. The one-piece flanged body shall be capable of remaining in-line if removal of the cutter cartridge and drive assembly is required for service.

2. The inside profile of the main housing shall be concave to follow the radial arc of the cutters. To direct larger particles toward the cutters and assure fineness of grind, the main housing shall maintain a clearance not to exceed 5/16-inch (8-mm) between the major diameter of the cutter and the concave arc of the housing.
3. The main housing shall be provided with a covered access port for equipment inspection. Inspection port covers shall be ASTM A 536-84 ductile iron.

D. Maintenance and Service Components
1. A maintenance stack screw and an easy access opening shall be provided in the top cover of the grinder to allow external tightening of the cutter stacks.
2. A maintenance bar screen for temporary use during maintenance operations shall be provided and sized to fit into the grinder housing when the cutter cartridge has been removed, allowing temporary resumption of flow during routine maintenance only.

E. Cutting Cartridge and Drive Assembly:
1. The cutter cartridge and drive assembly shall be removeable from the housing as a complete assembly without further disassembly. The components of that assembly include cutters, spacers, shafts, reducer, motor, bearings, and seals.
2. The inside configuration of both the individual cutter and individual spacers shall be hexagonal to fit the shafts with a total clearance not to exceed 0.015-inch (0.38-mm) across the flats to assure positive drive, minimize wear on the cutters, and increase the compressive strength of the spacers.
3. Individual cutters and spacers shall be AISI 4130 Heat Treated Alloy Steel, surface ground for uniformity and through-hardened to a minimum 45-50 Rockwell C.
4. Cutter configuration shall consist of one shaft with individual 5-tooth double-edged cutters and one shaft with individual 11-tooth cam cutters. To maintain particle size, the height of the tooth shall not exceed ½-inch (13-mm) above the root diameter. Cutter to cutter root diameter overlap shall not be less than 1/16-inch (1.6-mm) or greater than 1/4-inch (6-mm) to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.
5. The cutter shall exert a minimum of 450-lbs./HP (2680-N/kW) continuously and 1430-lbs./HP (8530-N/kW) at momentary load peaks at the tooth tip.
6. Grinder drive and driven shafts shall be made of AISI 4140 Heat Treated Hexagon Steel with a tensile strength rating of not less than 149,000-psi (1,027-MPa). Each shaft diameter shall be a minimum of 2-inches (51-mm).
7. The speed reducer shall be a grease filled planetary type of reducer with "Heavy Shock" load classification. The reduction ratio shall be 29:1. The high-speed shaft of the grinder shall be directly coupled with the reducer using a two-piece coupling.
8. The motor shall be TEFC design, 3-HP (2.2-kW), 1725-rpm, 460-volt, 3-phase, 60 Hz. Motor service factor shall be 1.15, the efficiency factor not less than 81% at full load and the power factor not less than 75% at full load.
9. The required continuously running torque per Horsepower (kW) shall be 1000 in-lbs. (152-Nm) minimum and monetary load peaks of 3300 in-lbs. (500-Nm).
10. Cutter cartridge seal housings and cover shall be cast of ASTM A 536-84 ductile iron and designed to protect the seal labyrinth while guiding particles directly into the cutting chamber.

F. Bearings and Seals
1. Rated Life: L10 of 100,000 hours under continuous operation.

2. The cutter shaft's radial and axial loads shall be borne by a sealed oversize deep-groove (Conrad type) ball bearing at each end. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and end face mechanical seals. Face materials shall be a minimum of tungsten carbide to tungsten carbide, not requiring and external flush or any periodic lubrication.
3. Products requiring continuous or occasional lubrication or flushing shall not be accepted.
4. The mechanical seal shall be rated at 90-psi (620-kPa) continuous duty by the seal supplier.
5. The bearings and seals shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The cartridges shall be independent of the stack height; therefore, cutter stack tightness shall not affect seal performance. The seal faces shall maintain their factory set preload independent of the cutter stack tightness.
6. Seals shall meet required pressure ratings of cutter stack fit. Independent seal design shall provide protection against axial loading on shafts and bearings during shaft deflection.
7. O-rings shall be made of Buna-N elastomers.
8. Each seal face shall be locked to provide positive drive on the rotating face and a positive lock on the static face. This positive lock on the seal faces is critical to long seal life in application where frit or other abrasive materials are present.

G. Lubrication:
1. Lubricate moving parts according to manufacturer recommendations.
2. Type: Oil.
3. Furnish sight glass for determining oil level.

2.2 Motor Controller

A. General
1. The controller shall be equipped with a HAND-OFF/RESET-AUTO three-position selector switch. In OFF/RESET the grinder shall not run. In HAND the grinder shall run. In AUTO, the grinder start and stop shall be controlled by a remotely located dry contact such that the grinder is activated with operation of the rotary lobe sludge pumps.
2. When a grinder jam condition occurs, while running in either the HAND or AUTO mode, the motor controller shall stop the grinder and reverse its rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. If the jam condition still exists, the controller shall go through two additional reversing cycles within 30-seconds (3-times total) before signaling a grinder overload condition. When a grinder overload condition occurs, the controller shall shut the grinder off and activate a fail indication.
3. If the grinder is stopped due to a fail condition and a power failure occurs, the fail indicator shall reactivate when power is restored.
4. Controller reset shall be from local panel controls only.
5. The controller shall have indicator lights for POWER ON, RUN, and FAIL conditions.
6. The controller shall provide overcurrent protection for the motor through an overload relay mounted directly on the contactor.
7. The controller shall be rated 3-HP, 460 volts, 3 phase, 60Hz.

B. Components
1. Enclosures shall be NEMA 4X, fabricated of fiberglass reinforced polyester resins and shall be suitable for wall mounting. Doors shall have hinges and corrosion resistant

latches. Enclosure shall house the control devices, relays, terminal blocks, and reversing motor starter.

2. Control Devices
    a. Pilot devices mounted on the enclosure front panel. Indicators shall be integral transformer type with low voltage long life 6-volt lamps.
    b. Lamps and the selector switch shall be heavy duty NEMA 4X type.
    c. Two normally open status contacts shall be provided. One for a RUN signal and one for FAIL signal. The contacts shall be rated at 2-Amp, 120-VAC, resistive load.
3. Reversing Motor Starter
    a. Starter shall be a full voltage reversing type with 120-volt operating coils.
    b. Forward and reverse contactors on the starter shall have both mechanical and electrical interlocks.
    c. The overload (OL) relay shall be adjustable so that the range selected includes the FLA (full load amperes) rating and service factor.
4. Output

    Remote dry contact outputs shall be provided for the plant SCADA system for the following:
    a. Operation status
    b. High temperature
    c. Fault alarm

C. Accessories:
1. Macerator and Motor Anchor Bolts and Nuts: ASTM F593, Type 316 stainless steel.

2.3 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 EXECUTION

3.1 Each grinder and controller shall be factory tested to ensure satisfactory operation. Each in-line unit shall pass a factory conducted hydrostatic test.

3.2 The grinder and controller shall be installed in accordance with the supplier's installation instructions and in compliance with all OSHA, local, state, and federal codes and regulations to include testing for proper alignment, startup and operation of unit.

3.3 Painting:

A. As specified in Section 09 90 00 - Painting and Coating.

B. Provide two factory-applied finish coats according to manufacturer recommendations.

3.4 The supplier shall provide the services of a factory trained representative for a minimum 8-hour period excluding travel to check installation, start-up the grinder, provide operation and maintenance

training to the OWNER’s personnel. Factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied.

3.5 Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

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SECTION 46 33 33
POLYMER BLENDING AND FEED EQUIPMENT (PDS-500, PDS-601 & PDS-602)

1.1 GENERAL

A. The contractor shall furnish and install three (3) polymer preparation systems as shown on the plans in the Rotary Drum Thickener Building and Sludge Dewatering Building and specified herein and including the following major components per system:
   1. Polymer pump
   2. Polymer activation system
   3. Sight glass
   4. Aging tank
   5. Water piping and controls
      Control panels compatible of automatic control from the Rotary Sludge Presses (RSP-3 and RSP-4) or Rotary Drum Thickener (RDT-500) equipment.
   6. Calibration cylinder.
   7. Polymer tote scissor lift.

B. Each system shall be a complete unit which dilutes and activates all emulsion polymers. The unit shall be designed for operation at a maximum of 100 psi at 100°F. The unit shall be tested at 150 psi.

C. The equipment manufacturer will be responsible for providing a complete system as described herein, and for delivering the equipment to the job site. The equipment shall be installed by the contractor, who will be responsible for off-loading the equipment, providing temporary storage and installing the equipment in place. Installation will include mounting the unit, piping the unit, and providing power and control wiring to the unit.

D. All equipment specified herein shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, engineering data, specifications, instructions, and recommendations of the equipment manufacturer. The polymer preparation equipment shall be the product of suppliers regularly engaged in the design and manufacture of polymer preparation systems and shall be specifically designed for the intended service. Appurtenant equipment shall be new and shall be designed, fabricated and assembled in accordance with the best engineering and shop practices. Individual parts shall be manufactured to standard sizes and gauges. Components shall be designed for the stresses which may occur during fabrication, shipping, erection or maintenance. Materials shall be suitable for service conditions as described herein.

E. The unit shall be completely tested in the assembly facility.

1.2 RELATED WORK

A. See the following specifications for related work:
   1. Section 01 33 01 - Submittal Procedures EPMS
   2. Section 01 43 13 - References
   3. Section 44 46 16 - Rotary Sludge Press Equipment
   4. Section 46 71 33 - Rotary Drum Thickening Equipment

5. Division 26 - Electrical

1.3 REFERENCE STANDARDS

A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
   1. American National Standard Institute (ANSI)
   2. Occupational Safety and Health Administration (OSHA)
   3. National Electrical Manufacturers Association (NEMA)
   4. National Electrical Code (NEC)
   5. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 SUBMITTALS

A. The contractor / manufacturer submittals shall include the following:
   1. Shop Drawings
   2. Equipment Layout Drawings
   3. Pump Data
   4. Complete Wiring Diagram.
   5. Catalogues, bulletins etc. of the equipment.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. The equipment shall be coordinated with the Sludge Filter Presses (RSP-3 and RSP-4) and Sludge Rotary Drum Thickener (RDT-500) and shall be operationally compatible.

B. Approved equal conforming to these specifications and provisions.

2.2 SYSTEMS REQUIRED

| | | | |
|---|---|---|---|
| System Tag No. | | PDS #500 | PDS #601 & #602 |
| Related Equipment Control | | Rotary Drum Thickener (RDT-500) | Rotary Sludge Presses (RSP-3 & RSP-4) |
| Neat Polymer Type | | Cationic – Polyacrylamide Emulsion | Cationic – Polyacrylamide Emulsion |
| Max Polymer Solution Feed Rate | gpm | 50 | 10 |

| | | | |
|---|---|---|---|
| Max Rated Neat Polymer Feed | gph | 15 | 3 |
| Max System Operating Pressure | pisg | 100 | 100 |

2.3 MATERIALS

A. The frame shall be of stainless steel for corrosion resistance. All fasteners shall be stainless steel. No coated steel or aluminum components may be used. The frame shall be designed for easy access to all components.

B. The polymer pump shall have all wetted metal parts made of 316 ss. The activation apparatus components shall be made of PVC, acrylic, and stainless steel. Electrical components shall be assembled in watertight non-metallic enclosures. Polymer piping shall be plastic. Polymer valves shall be polypropylene or stainless steel. The calibration column shall be polypropylene. The polymer injection valve shall have a Hastelloy-C spring. The solenoid valve shall be brass.

2.4 POLYMER PUMP.

A. The pump is to be a progressive cavity type, by NETZSCH or approved equal. Neat polymer feed range is 0.6 to 9 GPH. Pump shall have a stainless steel body and rotor, a Viton Lined stator, and mechanical shaft seal. The pump motor is to be TEFC, 90 VDC. The pump maximum speed is to be less than 600 RPM.

B. The pump speed can be controlled locally or by the dilution water flow, to maintain solution concentration.

C. A low polymer flow switch. The switch monitors the neat polymer flow. It is a thermal dispersion type switch, with no moving parts. The sensor is to be by Turck or approved equal. The trip point is field adjustable down to 0.6 GPH. An adjustable time delay minimizes nuisance trips. Low polymer flow activates an alarm and the feeder shuts down. Manual restart is required.

D. A 500 cc polypropylene calibration cylinder, with isolation valves, is to be included.

E. A 1-1/4" polymer strainer is to be included. The strainer has a polypropylene body and a 20 mesh stainless steel screen.

2.5 POLYMER ACTIVATION SYSTEM

A. The polymer activation system shall mix the water and polymer by hydraulic shear with no back mixing. Motor operated systems shall not be used. The activation system shall automatically compensate for changes in solution flow to provide constant activation energy. Systems which require the operator to manually adjust valves to set the activation energy levels will not be allowed.

## 2.6 SIGHT GLASS

A. The unit shall have a sight glass or system to allow the operator to see that it is operating properly. The sight glass shall be capable of disassembly, without using tools, and shall have a cleaning mechanism that does not require operator attention.

## 2.7 POLYMER PIPING

A. Polymer piping shall be of polypropylene and Sch 80 PVC with sections of polyethylene tubing or reinforced hose to allow easy disassembly. A polypropylene calibration cylinder and polypropylene isolation valves shall be included to allow checking the polymer pump flow rate. The polymer injection valve to the activation apparatus shall be easily accessible and able to be disassembled and re-assembled without disturbing the other components. The valve is to have a PVDF body, Hastelloy spring, ceramic ball, and viton seat.

B. Supply two (2), 40 foot minimum lengths of appropriately sized reinforced polypropylene tubing for transfer of polymer from the dilution system to the polymer injection point(s) complete with all fitting necessary for jointing tubing sections for extension to the alternative injection point as shown on the drawings.

## 2.8 AGING TANK

A. The tank shall have a minimum 20 gallon capacity.

B. The tank is an in-line pressurized tank. No level controls or additional pumps are needed.

C. The tank shell is a composite with a polyethylene liner enclosed by a FRP shell.

D. Valves shall be provided to allow draining the tank and to provide vacuum relief.

## 2.9 WATER PIPING AND CONTROLS

A. A strainer, with a brass body and 60 mesh screen, traps debris that might foul components.

B. A solenoid valve, with a brass body, provides dilution water on-off control.

C. A pressure regulator with a brass body and a liquid filled stainless gage provide water pressure control.

D. A throttling brass automatic valve allows adjusting the dilution water flow. The controller shall be enclosed to IP-55 standards.

E. Dilution water flow range shall be 2 to 20 GPM.

F. The water flow shall be adjustable manually; or by the PLC, with PID control, to maintain solution concentration.

G. A magnetic style flowmeter, provides a 4-20 mA signal to the PLC to allow maintaining solution concentration. The flowmeter provides local indication of water flow, total water use, and water temperature.

H. The feeder pressure drop, at maximum flow, is to be 40 psi.

I. Low water flow will activate an alarm. If the water remains low for more than 10 seconds, the feeder shuts down. Manual restart is then required.

2.10 CONTROL PANEL

A. NEMA 4X, Non-metallic enclosure. It houses all electrical control components. All components shall be UL Listed.

B. PLC is Allen Bradley, Micro 850. OIT is Allen Bradley, Panelview Component Series.

C. A main disconnect switch, with external operating handle is provided.

D. System Shutdown Button. It turns off the pump and water flow.

E. In the event of power loss, the polymer pump and the water supply will be turned off. Manual restart is required.

F. The Operator Interface displays the following switches:
   1. Feeder Start-Stop. An "ON / OFF / AUTO" switch allows local or automatic start - stop control. When in the "AUTO" position, the feeder is controlled by a remote switch closure.
   2. Polymer Pump Speed. A "MANUAL / AUTO" switch determines how the pump speed is controlled. When the switch is in the "MANUAL" position, the pump speed is manually entered on a keypad on the Operator Interface. When the switch is in the "AUTO" position, the pump speed is controlled by the dilution water flow to maintain the desired concentration.
   3. Operator Interface displays the following information:
      a. Polymer Pump Flow. This is based on pump speed.
      b. Dilution Water Flow.
      C. Polymer Solution Concentration. It can be adjusted by the operator.
      D. Auto Mode for Remote Control. The OIT background changes color from green to white when all the Feeder and Pump switches are in Auto Mode. This gives the operator a local indication that the switches are in Remote or Auto Mode. A set of dry contacts close for remote indication.
      E. Alarms. The OIT background changes color to red when the system alarms. A set of dry contacts close for remote indication. The system monitors the following for alarms:
         1) Low Dilution Water Flow
         2) Low Polymer Pump Flow

G. Power requirement shall be 120 VAC, 20 Amps.

2.11 Scissor Lift- A floor level scissor lift table shall be provided for lifting a chemical supply tote to provide positive head on the progressive cavity pump shall be provided with the equipment with the following features:

| | | |
|---|---|---|
| A. | Chemical tote dimensions - | 48” x 40” base |
| B. | Minimum lifting weight capacity - | 4000 lbs |
| C. | Lift Height - | 30 inches |
| D. | Electrically operated - | 1 Hp, 115 v, 60 Hz, 1 phase power supply |
| E. | Control - | Hand operated control with 8’ cord |
| F. | Construction - | Steel w/ orange color finish |

2.12 SCADA SYSTEM OUTPUT

A. The control panel for each system shall be equipped with SCADA signals (by contacts wired to terminals located inside the control panel for the following:
   1. Polymer System HOA Out of Auto Condition
   2. Low Dilution Water Flow Alarm Condition
   3. Low Polymer Pump Flow Alarm Condition

PART 3 EXECUTION

3.1 Installation

A. It is the intent of these specifications that the equipment be installed complete and ready for operation in accordance with the specifications. Install all equipment in accordance with the manufacturer’s instructions.

3.2 ACCEPTANCE AND START-UP

A. The Contractor shall notify the Authority's Representative and the manufacturer in writing when the installation is ready for inspection. Notification must be given a minimum of 10 days prior to the start-up date.

B. The manufacturer shall provide experienced service personnel, for three (3) days in two (2) site trips, to start-up the units and train the owners’ operators.

C. A field test report and written certification to the OWNER and ENGINEER shall be provided that equipment and controls have been installed, successfully calibrated and tested to operate in accordance with the specifications and drawings and that the operation and maintenance instructions have been furnished to the ENGINEER.

## 3.3 WARRANTY

A. The overall equipment/system warranty shall be one year from start-up.

END OF SECTION

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SECTION 46 41 23
SUBMERSIBLE MIXERS (M-207, M-208, M-209 and M-210)

PART 1 GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete installation of four (4) submersible mixers and related equipment in the Post Equalization Basin as shown on the plans and specified herein.

1.2 Related Work

A. See the following specifications for related work:
   1. Section 01 33 01 - Submittal Procedures EPMS
   2. Division 26 - Electrical

1.3 References

A. Any reference to standard specifications refers to the most current published date of the following specifications unless noted:
   1. AWWA Specifications as listed.
   2. ASTM Specifications as listed.

1.4 Submittals

A. Shop Drawings shall be submitted to the ENGINEER for approval and shall include:
   1. Outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required.
   2. Certified factory operational test and characteristic curves showing field performance for each pump.
   3. Wiring and schematic diagrams including accessories.
   4. Recommended spare parts list.

B. Operation and Maintenance Manual shall be furnished for all mechanical equipment specified in this section. The manual shall contain a description of equipment, complete accessory and parts list, and complete installation, operation and maintenance instructions. Two copies of the manual shall be submitted for approval within 30 days after approval of shop drawings. After approval of the manuals, six (6) additional copies shall be furnished.

C. Factory Tests:
   1. The mixer manufacturer shall perform the below listed inspections and tests on each mixer before shipment from the factory. A written report stating these tests have been completed shall be supplied with each mixer at the time of shipment.
      a. Propeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.

b. A motor and cable insulation test for moisture content or insulation defects shall be made.
c. Prior to shipment, the mixer shall be run dry to establish correct rotation and mechanical integrity.

PART 2 PRODUCTS:

2.1 All materials for the submersible mixers and related equipment shall be new and shall be furnished by the CONTRACTOR in accordance with the following requirements:

A. General:
1. CONTRACTORs shall furnish submersible mixers, stainless steel masks with integral hoist, duplex controls and related mounting equipment as shown on the plans. The mixing equipment specified herein shall be the design and fabrication of a single manufacturer, which shall have sole source responsibility for said equipment.

B. Mixer Design:
1. Each mixer shall be equipped with a submersible direct drive electric motor capable of a minimum propeller thrust of 204 lbf and 4500 gpm mixing capacity.
2. The mixer(s) shall be capable of mixing secondary effluent to prevent solids deposition and algae formation in the OWNER's Post Equalization Basin following treatment within a Sequencing Batch Reactor biological treatment system.
3. The mixer(s) shall be able to be raised and lowered and shall be easily removed for inspection or service without the need for personnel to enter the mixing vessel.
4. A sliding guide bracket shall be an integral part of the mixer unit. The entire weight of the mixer unit shall be guided by a single bracket which must be able to handle all thrust created by the mixer. The standard mixer, with its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 ft.
5. Major mixer components shall be of 316 Stainless Steel construction. The oil housing cover plate shall be of corrosion resistant composite. All exposed nuts and bolts shall be of stainless steel. To insure that the low velocity area around the motor remains impervious to low pH, solids and or liquid attack, the motor housing exterior shall be made of 316 Stainless Steel.

C. Motor:
1. Each mixer motor shall be a minimum 6.17 HP designed for operation on 480 Volts, 3 Phase, 60 Hertz, 10.3 FLA. The total power draw shall not exceed 18.0 kW.
2. Each mixer shall be provided with 30 Ft. of power cable rated for submerged service. All cables shall be oil resistant chloroprene rubber jacketed.
3. The multi-pole motor shall be directly connected to the propeller to produce a minimum propeller speed of 841 RPM. The mixer motor shall be squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The stator winding shall be insulated with moisture resistant Class F insulation, which will resist a temperature of 155°C (311°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 at least ten (10) evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of

aluminum. The mixers shall be FM approved for use in NEC Class I, Division I, Groups C & D locations.

D. Elastomers:
   1. All mating surfaces where watertight sealing is required shall be machined and fitted with a single set of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

E. Propeller:
   1. The propeller shall be of 316 stainless steel dynamically balanced, non-clogging backward curved design. Each blade shall be laser cut and welded to the hub to ensure that the propeller is properly balanced. The propeller shall be capable of handling small solids and potential fibrous materials found in treated secondary effluent applications. The propeller shall have two (2) vanes, 15.8 inches in diameter with a blade angle of 15.8 degrees.

F. Cable Entry:
   1. The cable entry housing shall be an integral part of the back plate. The cable entry shall be comprised of a single cylindrical grommet flanked by stainless steel sealing washers designed with a close tolerance fit against the cable outside diameter and the entry inside diameter. This will provide a leak proof seal at the cable entrance without the need for specific torque requirements. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion.
   2. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection shall be made between the threaded compressed type binder post thus securely affixing the cable wires to the terminal board. The use of the terminal compressed type post and a terminal board O-ring shall render the motor compartment leak proof from any liquid, which may enter the terminal compartment. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

G. Bearings:
   1. The mixer shall rotate on two (2) permanently lubricated bearings. Bearings shall be of single row, deep grooved design and sized to transfer all radial and axial loads to the mixer housing and minimize shaft deflection for increased bearing and seal life. Bearings shall not require a pre-load and be maintenance free with a minimum L-10 rated life of 100,000 hours at design conditions.

H. Thermal Sensors:
   1. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches embedded in the end coils of the stator winding and set for 284°F (140°C). These shall be used in conjunction with, and supplemental to, external motor overload protection, and wired to the control panel.

I. Seal Failure

1. A leakage sensor shall be installed in the seal chamber prior to the stator chamber to give an early alarm prior to contaminants entering the stator chamber.

J. Oil Housing:
   1. The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design will allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.

K. Mechanical Seals:
   1. Each mixer shall be provided with two sets of lapped end face type mechanical seals running in oil reservoirs for cooling and lubrication. The mechanical seals shall contain positively driven rotary silicon carbide/tungsten carbide. In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing.
   2. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be considered acceptable or equal.

L. Mixer Mast and Hoist:
   1. A mixer mast shall be provided to mount the submersible mixer. The mast shall be constructed of 4-inch square, 304 stainless steel tubing. The length of the mast shall be as shown on the drawings. The mast shall be attached to the basin wall with and upper and lower stainless-steel brackets.
   2. The mast shall be provided with an integral 500-pound capacity stainless steel hoist consisting of a davit crane, platform mounted base socket, winch and 30 feet of stainless steel cable. The boom on the davit crane shall be custom designed to position the lifting point over the center of gravity of the mixer and provide sufficient clearance to permit lifting mixer over top of the tank wall.

M. Vortex Suppressor:
   1. A 304 stainless-steel vortex suppressor shall be included with each mixer. The vortex suppressor shall allow mixer operation at a minimum of 8" of clean water liquid depth over the mixer propeller tip without vortex formation at the surface of the liquid.

N. Controls:
   1. One control panel located at a central location shall be furnished to control all four (4) mixers. The controls shall be housed in a NEMA 4 X stainless enclosure and shall include the following components:
      a. Individual circuit breakers for each mixer.
      b. NEMA rated motor starters with overload contactors for each mixer.
      c. Hand-Off-Auto selector switches for each mixer.
      d. Relays for motor overtemp and moisture detection.
      e. Elapsed time meters.
      f. Voltage/phase monitor
      g. Condensate Heater
      h. Terminal Strip for connection of control and power wiring.

i. Level probe relays to stop mixers on low-level signal from probe and start when level returns to designated level.
j. One (1) single sensor, level sensing probe for low level mixer stop and mixer start level with stainless steel mounting bracket and flexible probe cleaner.
k. Contact closures for SCADA system input showing status of each mixer and any alarm condition.
l. Main disconnect switch for control panel feeder.

2. Controls to be mounted as shown on the drawings. Power and control cables for mixers shall terminate in the local disconnect switch shown on the drawings. Connecting wiring shall be installed in conduit from this local disconnect switch to the control panel.

O. SCADA System Output

1. The control panel shall be equipped with SCADA signals (dry contacts) wired to terminals located inside the control panel for the following minimum signals:
   a. Post Equalization 2 Mixer No. 6 Run Condition
   b. Post Equalization 2 Mixer No. 6 Fail Condition (Overload, Over Temperature, Seal Failure)
   c. Post Equalization 2 Mixer No. 6 HOA Out of Auto Condition
   d. Post Equalization 2 Mixer No. 7 Run Condition
   e. Post Equalization 2 Mixer No. 7 Fail Condition (Overload, Over Temperature, Seal Failure)
   f. Post Equalization 2 Mixer No. 7 HOA Out of Auto Condition
   g. Post Equalization 2 Mixer No. 8 Run Condition
   h. Post Equalization 2 Mixer No. 8 Fail Condition (Overload, Over Temperature, Seal Failure)
   i. Post Equalization 2 Mixer No. 8 HOA Out of Auto Condition
   j. Post Equalization 2 Mixer No. 9 Run Condition
   k. Post Equalization 2 Mixer No. 9 Fail Condition (Overload, Over Temperature, Seal Failure)
   l. Post Equalization 2 Mixer No. 9 HOA Out of Auto Condition

P. Anchor Bolts

1. All required anchor bolts of sufficient size and strength for installation of the mixer, mask and hoist in the existing concrete tank shall be provided with the equipment.

## PART 3 EXECUTION

### 3.1 HANDLING AND INSTALLATION

A. Handling: All equipment shall be carefully handled and protected from damage while in storage and during installation. Equipment shall be protected from weather at all times. Equipment damaged by weather, handling or construction shall be immediately repaired or replaced to the ENGINEER's satisfaction.

B. Installation: Equipment shall be installed in strict accordance with the manufacturer's instructions and approved shop drawings.

3.2 Service:

A. Equipment manufacturer shall furnish all instructional and assistance necessary for proper installation and operation of equipment. After installation, a qualified service representative of the equipment manufacturer shall inspect the complete installation, place the equipment in permanent operation, instruct the OWNER's personnel in operation and maintenance, and perform field tests to insure proper operation. A minimum of one (1) trip and eight (8) hour field time excluding travel shall be included for the checkout and instructions of Owner's personnel.

B. A report of the field test results shall be provided and included in the final service manual. The report as a minimum shall contain performance information pertaining to seal lubrication, proper rotation, power supply voltage, motor operating load and no-load current.

C. After installation and final testing, the manufacturer shall provide written certification to the OWNER/ENGINEER that all equipment is properly installed and that the plant operators have been instructed on proper operation and maintenance procedures.

D. The manufacturer's authorized service person shall perform an end of warranty service to determine mixer condition and perform any service required.

E. Spare Parts: The manufacturer is to furnish the OWNER, all spare parts normally recommended for each mixer to include as a minimum:
   1. Seal repair kit with seals
   2. Bearings
   3. O-rings.

3.3 Warranty: All equipment specified herein is to carry a minimum one-year warranty on all materials, workmanship and parts from date of acceptance.

A. END OF SECTION

SECTION 46 61 46
AUTOMATIC BACKWASH DISC FILTER EQUIPMENT (DF-4 & DF-5)

## PART 1 GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Section Includes: Supply and installation of two (2) new automatic backwash disc filters as shown on the drawings and as specified herein to include all valves, controls, piping connections, installation, commissioning services required to place the filters into coordinated operation with the Owner's existing three (3) filter units. The CONTRACTOR shall also relocate and install in the new Effluent Filter Building the Owner's three (3) existing Kruger disc filters including designated piping, valves and control panels to be reused plus supply all require new piping and designated equipment to be replaced.
   2. The disc filter shall consist of a central drum onto which the discs with the filter media panels are assembled. The rotating filter drum is supported on the front and rear ends by sleeve bearings. Each filter unit shall include center drum, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough, drive mechanism, automatic control system and components as specified.
   3. Filter shall be designed for installation as shown on the contract drawings/plans and shall be operationally compatible with the Owner's three (3) existing Kruger disc filters and related existing piping configurations. The two (2) new disc filters are to operate as a system and backwash in conjunction with the existing three (3) units. All five (5) units are to act as a system. All five (5) filters shall receive influent from a common influent piping manifold and discharging effluent to a common effluent piping manifold.

### 1.2 RELATED DOCUMENTS

A. Section 01 33 01 - Submittal Procedures EPMS

B. Division 26 - Electrical

C. Section 33 32 16 - Rotary Dum Filter Pump Station

D. Section 43 12 19 - Positive Displacement Blowers

E. Section 43 21 39 - Submersible Pumps

F. Section 44 46 16 - Rotary Sludge Press Equipment and Conveyors

G. Section 49 71 33 - Rotary Drum Thickening Equipment

### 1.3 QUALITY ASSURANCE:

A. Applicable Standards:
   1. ASTM -American Society for Testing and Materials
   2. AISI -American Iron and Steel Institute
   3. AGMA -American Gear Manufacturer's Association
   4. NEMA- National Electrical Manufacturer's Association

5. NEC -National Electric Code
6. AWS D1.6 - Structural Welding Code: Stainless Steel

B. To assure unity of responsibility, center tube, discs with filter media panels, support frame with cover, backwash spray assembly with pump, backwash trough, drive mechanism, automatic control system and components as specified shall be furnished and/or coordinated by a single manufacturer.

C. All painting shall be per Manufacturer's standards.

D. Experience of Equipment Manufacturers:
1. It is the intent of the contract documents to procure the best equipment and services that are available. The filtration equipment shall be furnished by a manufacturer who shall have at least ten (10) years' experience in the United States or fifteen (15) years' experience elsewhere in the design, production, assembly and field service of equipment of like type, size and capacity in similar applications. The equipment manufacturer must supply a list of at least fifty (50) successful installations in the United States utilizing equipment of like type in similar applications.
2. The equipment supplier must have manufacturing or warehouse facilities located in the United States including parts inventory, and personnel based in the United States and employed by the supplier to provide direct technical and field support. The equipment manufacturer must provide information supporting their ability to provide these services.
3. The disc filtration technology shall be accepted filtration technology for compliance with the State of California Water Recycling Criteria (Title 22).

E. Acceptable Manufacturer:
1. Consideration will only be given to other alternate manufacturers to the Owner Preferred Manufacturer who can demonstrate to the Engineer that their equipment complies with these Specifications and has successful and documented experience with the size, quality, performance and reliability equivalent to that specified herein. Consideration for any other alternate manufacturer shall include the proposed equipment's application and ability to provide equal service and performance as intended by these specifications. Alternate equipment manufacturers shall prepare and submit to the Engineer "Evaluation Documentation". The "Evaluation Documentation" shall be delivered to the Engineer in accordance with EJCDC® C-200 Instruction to Bidders EPMS. All modifications to structures, piping, valves, equipment layout, electrical connections, wiring and coordination with ancillary or interconnected systems or equipment necessitated by a substitution shall at the cost of the Contractor or alternative manufacturer.

F. The Equipment Manufacturer shall warrant the use of this system and its equipment will not infringe on any U.S. or foreign patent.

## 1.4 PERFORMANCE REQUIREMENTS

A. The disc filter System shall be capable of meeting the following performance requirements. The Manufacturer shall provide the disc filter units to complement the existing three (3) Kruger Hydrotech Discfilter units and controls onsite.

| **Performance Criteria, System** | **Value** |
|---|---|
| Peak Flowrate per unit, MGD* (gpm) | 4.20 (2,916) |
| Average Flowrate, MGD* (gpm) | ≤1.73 (1,201) |
| Maximum Influent TSS*, mg/L | ≤15 |
| Daily Average Influent TSS*, mg/L | ≤10 |
| Monthly Average Effluent TSS*, mg/L | ≤5 |
| **Filter Design Data** | |
| Filter Pore Size, µm | 10 |
| Filter Cloth Material | Polyester |
| Number of Existing Filter Units | 2 |
| Number of Proposed Units | 1 |
| Total Number of Filter Units | 3 |
| Number of Filter Discs per unit | 12 |
| Filter Disc Diameter, m | 2.2 |
| Effective Filter Surface Area per unit, $ft^2$ | 470.17 |
| | |
| | |
| **Filter Drive Unit** | |
| Drive Motor (1 per unit) | 1.5 HP, 460v, 3 phase |
| Drive Assembly | Drive Chain and Sprocket |
| **Backwash Cleaning System** | |
| Number of Backwash Nozzles (per Disc) | 10 |
| Backwash Pump (1 per unit) | 10 HP, 460v, 3 phase |
| Backwash Pressure, psi | 110 |
| Design Backwash Flowrate, gpm | 79 |

* Average TSS concentrations are based on analysis of 24 hr composite samples.

B. The automatic backwash filter system shall be suitable for filtering domestic wastewater after secondary treatment and clarification. Each filter shall be designed to operate on a continuous basis and shall be designed to operate while receiving varying flows.

C. The proposed disc filtration system shall not exceed a hydraulic loading rate of 6.2 gpm/sf at peak flow.

D. Filtration system shall utilize an "inside-out" flow pattern in which influent flows by gravity into the filter discs from the center drum. Solids are separated from the water by partially submerged filter media.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

A. All fabricated metal shall be minimum grade AISI 304 stainless steel, unless otherwise stated in this specification. All welding of structural members shall conform to the latest requirements of AWS D1.6. Filter panels shall be polyester filter cloth mounted on plastic frames with integrated rubber seals. Filter disc segments shall be injection molded ABS plastic.

B. The valves, equipment, materials of construction and controls specified under this section supersede valves, equipment, materials of construction and controls specified elsewhere in the contract documents. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.

C. The disc filtration units shall be fully preassembled and factory inspected prior to shipping the filtration units. Drive motor and backwash pump are to be installed at factory and provided integral to filtration unit.

D. Flange connections to be provided with AISI 304 stainless steel stub ends and loose galvanized flange collar rings.

2.2 INFLUENT VALVE

A. One (1), 16" lugged style influent butterfly valve shall be included with the filter. The valve shall include a cast iron body, aluminum bronze disk, stainless steel shaft and EPDM seat with a geared handwheel operator.

2.3 CENTER DRUM

A. The center drum shall be a water tight, one piece, structural welded, AISI 304 stainless steel fabrication, open at one end to allow the influent to enter, and have openings to the filter discs for water distribution to the filter media. The center drum shall have lubricated bearings, which must be externally accessible via grease tubing and fittings for routine lubrication.

2.4 DISC ASSEMBLY

A. The filter shall be composed of modular and removable discs. Each disc shall consist of disc segments that can be easily mounted or dismounted as required. The segments of one disc will be bolted to each other, and the completed disc assembly will be secured to the center drum with stainless steel band straps and hardware.

B. Filter panels (filter media) shall be mounted on the sides of the disc segments. The filter panels shall consist of 304 stainless steel frames with PET monofilament filter fabric attached to the frames. Systems with pleated media, corrugated media, pile cloth media, or stainless steel media shall not be acceptable. Stainless steel media shall also not be accepted due to its susceptibility to corrosion and short life span caused by mechanical fatigue failure. Each panel shall be equipped with a rubber gasket integral to the media frame to provide a watertight seal between the filter panels and disc segments. The panels will be held in place by a top cover.

C. Nominal media pore size shall not exceed 10 microns. Filtration systems utilizing media greater than 10 microns shall not be accepted.

D. The replacement of filter media must be possible from outside the filter tank by unfastening two bolts, removing the retaining cap and sliding panels from filter frame.

E. Filter discs must be constructed of modular segments and each disc segment must include a substantially open area along the length of the radial support to allow the liquid to flow from one section to the other as the discs are rotated.

## 2.5 SUPPORT FRAME WITH ENCLOSED TANK AND COVER

A. The support frame and tank shall be one piece, structural welded, 304 stainless steel. Onto the support frame shall be welded 304 stainless steel base plates for back-wash pump, drive gear box, and center shaft bearing house. Tank thickness shall be a minimum of 1/8" thickness. Carbon steel construction shall not be acceptable in order to minimize maintenance efforts associated with corrosion and painting.

B. The filter shall be furnished with a GRP (Glass fiber Reinforced Plastic) lockable cover as a means to prevent algal growth and to eliminate the presence of filter flies. One side of the cover shall have a single access lid that can be opened to allow operator access to all of the discs and backwash nozzles. The lid must include an assembly that provides the following: mechanical advantage to assist personnel in lifting the lid, full support of the lid when in the open position, and mechanical resistance/support when lowering the lid. This feature is important for ease of access and improved operator safety. Designs that incorporate removable lids, sliding lids, or propped lids (without mechanical lifting mechanism) will not be accepted.

C. Anchor bolts shall be provided by the contractor.

## 2.6 BACKWASH CLEANING SYSTEM

A. The disc filter shall be equipped with a single oscillating back-washing system with non-motorized moving spray headers for efficient cleaning of the filter cloth and for reduction of the consumption of backwash water. All panels shall receive 110 psi pressure backwash spray.

B. The backwash system shall be comprised of 304 stainless steel backwash spray headers installed between the discs. The spray headers shall oscillate in an upward and downward motion during drum rotation. The spray header oscillation shall be operated by a cam system that is connected to the drum drive. Each header shall have flat pattern spray nozzles for each disc side. The spray nozzles shall consist of ceramic nozzle tips, mounting cap for quick removal, nozzle body and seals. The nozzle system shall be Spraying Systems Co., Quick TeeJet, or approved equal. The replacement of spray nozzles must be possible from outside the filter tank. A swivel joint shall allow the spray header manifold to rotate out for nozzle access without disassembly of the manifold or headers.

C. Each filter shall have one externally mounted low-pressure Grundfos Model CR15-5 (or equal) centrifugal pump for the backwash system and shall be installed at the factory. The backwash pump shall be provided integral to the Disc filter unit. The backwash pump shall be of the vertical multi-stage design with the motor mounted directly to the top of the pump. The pump

suction and discharge fittings shall be ANSI flanged, 2" fittings. The pump suction/discharge chamber, motor stool and pump shaft coupling shall be constructed of cast iron. The impellers, pump shaft, diffuser chambers, outer discharge sleeve and impeller seal rings or seal ring retainers shall be constructed of stainless steel. The impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement. Pump shall be equipped with a balanced cartridge type mechanical seal assembly with Silicone Carbide/Silicon Carbide seal faces and EPDM rubber O-rings mounted in stainless steel components. The motor shall be supplied integral with the pump. The motor shall be standard efficiency rated for 10 HP, 460V, 3 phase, 60 HZ operation and shall be NEMA C face design, Totally Enclosed Fan Cooled (TEFC) with a minimum service factor of 1.15. Filtered water shall be pumped via a 304 stainless steel suction pipe and discharged from the pump to the backwash header piping constructed of 304 stainless steel. A ball valve and pressure gauge shall be installed in the backwash header piping downstream of the pump in order to regulate to the desired nozzle pressure.

D. The two (2) new disc filters and one (1) exiting disc filter (with a plastic filter unit) shall be provided with flanged backwash strainer units with stainless steel housing. Each filter unit shall include a removable top for access to the filter element and a bottom drain and valve for flushing the strainer to drain.

E. The two (2) new disc filters shall be equipped with a backwash-collecting trough for removing solids. The trough shall be constructed of 304 stainless steel. The trough length shall be sufficient to capture reject water from all filter discs. The trough shall be elevated to prevent contact with the influent stream. The reject water shall leave the trough by gravity via the backwash outlet connection. Piping from the trough to the outlet connection shall be 304 stainless steel connected with stainless steel shielded, flexible elastomeric PVC couplings. The backwash outlet connection shall be a 6 inch ANSI loose flange.

## 2.7 DRIVE MECHANISM

A. The drive assembly shall consist of a single gearmotor, polyamide drive sprockets, and investment cast stainless steel drive chain. The chain link and barrel material shall be 15-5pH stainless steel. The chain pin material shall be 17-4 pH stainless steel material. Link, pin, and barrel hardness shall be 415 BHN. The chain shall have an ultimate strength of 35,000 lb and an ASME working load of 4,500 lbs. Manufacturing method, material type, hardness, strength, and working load requirements are essential to provide durability, abrasion resistance, corrosion resistance, and long life for this application.

B. The drive assembly shall also provide oscillation of the backwash spray headers without the need for a separate drive motor in order to provide for efficient cleaning of the filter media with minimal water usage and minimal energy usage.

C. The gear motor shall be SEW Eurodrive shaft mounted helical worm gear with integral standard AC induction motor, SEW gear motor model S77DRE90M4. The drive motor shall be provided integral to the disc filter unit and shall be installed at the factory. The gear ratio shall be 189.09. The motor shall be standard efficiency TEFC rated for 1.5 HP, 460V, 3 phase, 60HZ operation.

D. Reducer design end rating shall equal or exceed AGMA requirements. Speed reducers shall be selected for not more than AGMA class I service.

2.8 FLOW BYPASS

A. A bypass chamber shall be supplied integral to the filter unit to allow for diversion of unexpected high inlet water level without contamination of the filtered effluent. The bypass chamber shall be at the inlet side of the filter unit. The bypass connection shall be a 20 inch ANSI loose flange.

2.9 ACCESS PLATFORM AND STEPS

A. The CONTRACTOR shall furnish one (1) new access platform and steps as shown on the drawings for access to Disc Filter DF-4 and Disc Filter DF-5. The platform and steps shall be constructed of aluminum structural members and grating of a similar design and arrangement to the existing platforms.

2.10 DISC FILTER SPARE PARTS

A. The following spare parts will be supplied: 3 Backwash Spray Nozzles, 3 Filter Panels. Parts inventory shall be based in the United States.

2.11 DISCFILTER 5 CONTROL PANEL AND OPERATION

A. The disc filter operation shall be managed by an automated control system. The automatic control will be designed around a Programmable Controller (Allen Bradley CompactLogix). The control panel will communicate with the existing three Discfilter Local Control Panels and new Discfilter 4 Local Control Panel via Allen Bradley Ethernet/IP communication protocol. The control system shall be programmed so that the Discfilters will operate as a five unit system.

B. The control system is an integral part of the disc filter system and shall be provided in a UL labeled, NEMA 4X 304 Stainless Steel enclosure. Discfilter 5 Local Control Panel shall include a control system which shall consist of a programmable controller, fused main disconnect, control transformer, branch circuit breakers, IEC motor starter/protector, hand-off-automatic switches, and liquid level sensor relay for initiating backwash. The power feed to the control panel shall be 480VAC 60Hz 3 phase, control voltage shall be 120VAC 60 Hz 1 phase.

C. The control panel enclosure shall meet the following criteria, NEMA 4X, 304 Stainless Steel, seams continuously welded and ground smooth, seamless foam-in-place gasket for watertight dust-tight seal, door opens 180°, quarter turn latches opened or closed using a screw driver. Saginaw SCE42EL3612SSLP or approved equal.

D. The main disconnect shall be enclosed in the control panel, with a handle mechanism extending through the door. The main disconnect shall be a fused disconnect rated for 30 Amps 3-Pole.The main disconnect shall be composed of three primary components; 30A fused disconnect, extension shaft, NEMA 4X operating handle. Square D 9421 NC3 fused disconnect, 9421 NW2 disconnect handle and 9421 NS36 disconnect shaft or approved equal.

E. Each filter shall be equipped with an adjustable water level sensor located in the influent chamber for the purpose of backwash initiation. The high level sensor shall be a height adjustable PVC encapsulated 316 SS Rod with a diameter of 5/16” and length of 12”, and shall include a PVC encapsulated copper conductor with control wire connected at top of probe. The installing Contractor is to provide wiring and conduit to connect the level sensor to a liquid level relay located in the Disc filter Control Panel. The liquid level relay is activated when the level sensor comes in contact with water in the influent chamber. The liquid level relay for backwash shall be

Square D SSAC LLC44A5A with relay base or approved equal.

F. Each filter unit will be supplied with a high high level sensor. The device used for the high high level sensor will be the same part(s) and number used for the high level sensor. The high high level sensor will be mounted in such a way as to insure that the device indicates when the water reaches a height above the backwash level sensor and has entered a high level scenario. When the high high level sensor is activated, it will activate a relay inside the control cabinet and a pilot light on the front of the control panel will illuminate. The pilot light will be labeled "Disc Filter High High Level". The high high level relay will have a spare set of normally open dry contacts available for monitoring. The liquid level relay shall be Square D SSAC LLC44A5A with relay base or approved equal.

G. Each filter unit will be supplied with a BW pump dry run protection level sensor. The device used for the dry run protection sensor will be the same part(s) and number used for the backwash level sensor. The sensor will be mounted in such a way as to insure that the device indicates when the water reaches a height below the effluent weir that would risk pump dry run. When the sensor is activated, it will activate a relay inside the control cabinet to prevent running the pump. The level relay will have a spare set of normally open dry contacts available for monitoring.

H. Field wiring terminal blocks for the Disc Filter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 30 Amps. The field wiring terminal blocks shall be Phoenix UTTB4 3044814 or approved equal.

I. Motor wiring terminal blocks for the Disc Filter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 65 Amps. The field wiring terminal blocks shall be Phoenix UT10 3044160 or approved equal.

J. A motor starter located in the Disc filter Control Panel will manage the start/stop of the Backwash Pump motor. The motor starter will be sized appropriately to match the requirements of the Backwash Pump motor. The motor starter will be an IEC starter, rated 0.1 ~ 25Amps @ 460VAC 3 phase, ½ ~ 20HP @ 460VAC 3 phase, rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys U or approved equal.

K. A VFD located in the Disc Filter Control Panel will manage the start/stop of the Filter Drum motor. The VFD will be sized appropriately to match the requirements of the Filter Drum motor. The VFD will be equipped with an integral keypad display for VFD interface and configuration, use sensorless flux vector technology, use with 3-phase asynchronous motors, monitoring and control inputs and outputs, motor and drive protection. The VFD will not require input/output filters or harmonic testing. The VFD will be hardwired for control and monitoring and will not require any communication protocols such as Ethernet, DeviceNet, and Modbus. The VFD shall be Square D Altivar 320 or approved equal.

L. The control panel shall be equipped with the following signals to be made available to the Plant SCADA via Allen Bradley Ethernet IP protocol. Signals typical for each Discfilter.
   1. Drive operation status
   2. Backwash pump status
   3. Filter high level alarm
   4. Time of day and date year
   5. Water level in filter (High Level, High High Level, Low Level)

6. Time since last backwash
7. Elapsed time on drive motor
8. Elapsed time on backwash pump
9. Total backwash time
10. Backwash pump fail
11. Filter drum auto
12. Filter drum run time
13. Filter drum fail
14. Backwash requested
15. HOA Not in Auto position.

M. The control panel shall have external pilot lights mounted on the door indicating run status of the filter unit and backwash pump. The pilot lights will be NEMA 4X, 120VAC, standard (push to test) and 30mm. The pilot lights shall be Square D 9001 SKP1x31 or approved equal.

N. The control panel shall have external selector switches (Hand-Off-Automatic). The selector switches will be NEMA 4X, 30mm, non-illuminated, manual return and equipped with contact blocks. The selector switches shall be Square D 9001 SKS43BH2 or approved equal. The control panel selector switches will allow the drum drive and backwash motor to be operated in Hand mode.

O. The completed control panel shall be UL labeled per UL508A. The completed control panel will be factory tested and configured.

P. The Programmable Controller will perform logic, timing, counting and real time clock operations. The Programmable Controller will be programmed using software to allow configuration of a downloadable program featuring input instructions, output instructions, timer instructions, counter instructions and counter instructions. The Controller shall be an Allen Bradley CompactLogix 1769-L33ER or approved equal.

Q. The Control System will be supplied with one Operator Interface. The Operator Interface will be capable of interacting with the Programmable Controller. The Operator Interface will be capable of displaying text and graphics, allow operator setpoint entry, and provide system status display. The Operator Interface will be a color touchscreen display, minimum four (4) inch diagonal, 10/100 Base-T Ethernet Port and mount to the panel front. The Operator Interface will be Allen Bradley PanelView Plus 7 or approved equal.

R. Control system will also allow for continuous back washing in HAND mode.

S. The Contractor is responsible for providing Interconnecting wiring and/or conduit between the supplied control panel and disc filter equipment. The Contractor shall provide any junction or pull boxes or any other like device needed to supply the interconnecting wiring.

T. All field connections/terminations to the supplied control panels, the disc filter equipment and between the disc filter and supplied control panels shall be the responsibility of the Contractor.

## 2.12 DISCFILTER 4 CONTROL PANEL AND OPERATION

A. The Discfilter 4 Control Panel shall include Allen Bradley CompactLogix Flex I/O modules to communicate to the CompactLogix PLC located in the Discfilter 5 Local Control Panel.

B. The control system is an integral part of the disc filter system and shall be provided in a UL labeled, NEMA 4X 304 Stainless Steel enclosure. Discfilter 5 Local Control Panel shall include a control system which shall consist of a programmable controller, fused main disconnect, control transformer, branch circuit breakers, IEC motor starter/protector, hand-off-automatic switches, and liquid level sensor relay for initiating backwash. The power feed to the control panel shall be 480VAC 60Hz 3 phase, control voltage shall be 120VAC 60 Hz 1 phase.

C. The control panel enclosure shall meet the following criteria, NEMA 4X, 304 Stainless Steel, seams continuously welded and ground smooth, seamless foam-in-place gasket for watertight dust-tight seal, door opens 180°, quarter turn latches opened or closed using a screw driver. Saginaw SCE42EL3612SSLP or approved equal.

D. The main disconnect shall be enclosed in the control panel, with a handle mechanism extending through the door. The main disconnect shall be a fused disconnect rated for 30 Amps 3-Pole.The main disconnect shall be composed of three primary components; 30A fused disconnect, extension shaft, NEMA 4X operating handle. Square D 9421 NC3 fused disconnect, 9421 NW2 disconnect handle and 9421 NS36 disconnect shaft or approved equal.

E. Each filter shall be equipped with an adjustable water level sensor located in the influent chamber for the purpose of backwash initiation. The high level sensor shall be a height adjustable PVC encapsulated 316 SS Rod with a diameter of 5/16” and length of 12”, and shall include a PVC encapsulated copper conductor with control wire connected at top of probe. The installing Contractor is to provide wiring and conduit to connect the level sensor to a liquid level relay located in the Disc filter Control Panel. The liquid level relay is activated when the level sensor comes in contact with water in the influent chamber. The liquid level relay for backwash shall be Square D SSAC LLC44A5A with relay base or approved equal.

F. Each filter unit will be supplied with a high high (alarm) level sensor. The device used for the high alarm level sensor will be the same part(s) and number used for the high high (alarm) level sensor. The high high (alarm) level sensor will be mounted in such a way as to insure that the device indicates when the water reaches a height above the backwash level sensor and has entered a high level scenario. When the high high (alarm) level sensor is activated, it will activate a relay inside the control cabinet and a pilot light on the front of the control panel will illuminate. The pilot light will be labeled "Disc Filter High High Level". The high high (alarm) level relay will have a spare set of normally open dry contacts available for monitoring. The liquid level relay shall be Square D SSAC LLC44A5A with relay base or approved equal.

G. Each filter unit will be supplied with a BW pump dry run protection level sensor. The device used for the dry run protection sensor will be the same part(s) and number used for the backwash level sensor. The sensor will be mounted in such a way as to ensure that the device indicates when the water reaches a height below the effluent weir that would risk pump dry run. When the sensor is activated, it will activate a relay inside the control cabinet to prevent running the pump.

The level relay will have a spare set of normally open dry contacts available for monitoring.

H. Field wiring terminal blocks for the Disc Filter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 30 Amps. The field wiring terminal blocks shall be Phoenix UTTB4 3044814 or approved equal.

I. Motor wiring terminal blocks for the Disc Filter Control Panel will be din rail mountable, individually numbered, rated for 600 Volts 65 Amps. The field wiring terminal blocks shall be Phoenix UT10 3044160 or approved equal.

J. A motor starter located in the Disc filter Control Panel will manage the start/stop of the Backwash Pump motor. The motor starter will be sized appropriately to match the requirements of the Backwash Pump motor. The motor starter will be an IEC starter, rated 0.1 ~ 25Amps @ 460VAC 3 phase, ½ ~ 20HP @ 460VAC 3 phase, rotary handle operator, visible trip indication, protection by overload, short circuit, undervoltage and shunt. The motor starter will be equipped with auxiliary contacts for monitoring and control. The IEC motor starter shall be Square D TeSys U or approved equal.

K. A VFD located in the Disc Filter Control Panel will manage the start/stop of the Filter Drum motor. The VFD will be sized appropriately to match the requirements of the Filter Drum motor. The VFD will be equipped with an integral keypad display for VFD interface and configuration, use sensorless flux vector technology, use with 3-phase asynchronous motors, monitoring and control inputs and outputs, motor and drive protection. The VFD will not require input/output filters or harmonic testing. The VFD will be hardwired for control and monitoring and will not require any communication protocols such as Ethernet, DeviceNet, and Modbus. The VFD shall be Square D Altivar 320 or approved equal.

L. The control panel shall have external pilot lights mounted on the door indicating run status of the filter unit and backwash pump. The pilot lights will be NEMA 4X, 120VAC, standard (push to test) and 30mm. The pilot lights shall be Square D 9001 SKP1x31 or approved equal.

M. The control panel shall have external selector switches (Hand-Off-Automatic). The selector switches will be NEMA 4X, 30mm, non-illuminated, manual return and equipped with contact blocks. The selector switches shall be Square D 9001 SKS43BH2 or approved equal. The control panel selector switches will allow the drum drive and backwash motor to be operated in Hand mode.

N. The completed control panel shall be UL labeled per UL508A. The completed control panel will be factory tested and configured.

O. Control system will also allow for continuous back washing in HAND mode.

P. The Contractor is responsible for providing Interconnecting wiring and/or conduit between the supplied control panel and disc filter equipment. The Contractor shall provide any junction or pull boxes or any other like device needed to supply the interconnecting wiring.

Q. All field connections/terminations to the supplied control panels, the disc filter equipment and between the disc filter and supplied control panels shall be the responsibility of the Contractor.

2.13 MODIFICATIONS TO EXISTING DISCFILTER 1-3 LOCAL CONTROL PANELS

A. The existing three Discfilter Local Control Panels shall be modified to include CompactLogix Flex I/O modules, 24VDC power supply, and an Ethernet Switch. Each Local Control Panel shall require an RJ-45 Ethernet connection to the Discfilter 5 Local Control Panel.

B. Dry contacts that already exist in the Local Control Panels will be wired to the Flex I/O Modules.

PART 3 EXECUTION

3.1 GENERAL

A. Contractor shall install the new and relocated disc filter equipment per the Equipment Manufacturer's directions and the drawings. The Contractor will provide all supports and anchoring required to install the disc filter unit. The plumbing/interconnecting piping, electrical connections, grating and handrails shall be provided by the Contractor as detailed on the drawings and specifications. The Equipment Manufacturer shall provide adequate protection of the equipment for shipment to the project site. Installation instructions will be provided that specifically outline installation of the disc filter. Lifting instructions shall be provided to assist the Contractor.

B. In addition to the normal Installation, Operation and Maintenance Manuals required by contract, a spare manual shall be shipped with the equipment to allow for proper operation of equipment prior to final release of all final Installation, Operation and Maintenance Manuals to the end user.

3.2 FIELD SERVICES

A. The Equipment Manufacturer shall furnish the services of a factory-trained representative based in the United States and employed by the manufacturer, for a minimum of four (4) working days and two (2) separate trips. These two trips shall consist of one (1) trip to monitor the installation and one (1) trip for start-up and instruction of plant operating personnel. The field services shall include checkout, startup, adjustment and placement of equipment into operation under a fully automated condition.

B. The Owner shall be responsible for influent / effluent testing to document performance conditions.

C. Upon completion of the startup, the Equipment Manufacturer shall provide a written certification to the OWNER/ENGINEER that the new and relocated equipment is properly installed and that the plant operators have been instructed on proper operation and maintenance.

## PART 4 WARRANTY

### 4.1 GENERAL

A. The Equipment shall materially conform to the description in this Specification and the Contract Documentation and shall be free from defects in material and workmanship. Warranty periods are 18 months from delivery or 1 year from beneficial use, whichever occurs first.

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SECTION 46 71 33
ROTARY DRUM THICKENER (RDT-500)

## PART 1 GENERAL

### 1.1 SUMMARY

A. The Contractor shall furnish and install one (1) rotary drum thickener (RDT) system consisting of a floc development tank, driven impeller, multiple stage rotary drum with filtration media, supporting frame, spray deflection covering, spray wash header, return water collection tank and polymer mixing system.

B. The sludge mixed with chemicals enters the floc development tank tangentially at the bottom and completes its flocculation. The flocculated solid and liquid flow from a tangential outlet into the rotary drum screen through a step-down header. In the rotary drum screen the liquid separates from the flocculated solids through the woven wire mesh, is collected in the return water tank and exists through a drain in the bottom. The solids pass through four (4) dewatering stages before being discharged from the end of the unit. Mounted above the rotary drum screen is a self-cleaning wash water spray header. This spray header keeps the rotary drum screen openings clear of solids.

### 1.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. The rotary drum thickener performance shall be guaranteed to achieve the following performance of sludge thickening:
   1. Inlet feed rate up to 400 gpm of blended waste activated and/or aerobically digested sludge.
   2. Feed sludge solids ranging from 0.5% to 1.5%.
   3. Final discharge thickened solids consistency of 5 to 7% solids.
   4. Average solids capture efficiency of 98%.
   5. Typical polymer usage at 5 – 7 lbs. (100% active)/ton of sludge (dry wt.)

### 1.3 RELATED WORK

A. See the following specifications for related work:
   1. Section 01 33 01 - Submittal Procedures EPMS
   2. Section 01 70 00 - Execution and Closeout Procedures
   3. Section 33 32 16 - Rotary Drum Thickener Pump Station
   4. Section 40 91 16 - Magnetic Flow Meter & Recorder
   5. Section 43 12 19 - Positive Displacement Blowers
   6. Section 43 21 36 - Rotary Lobe Pumps
   7. Section 43 21 39 - Submersible Pumps
   8. Section 44 46 16 - Rotary Sludge Press Equipment and Conveyors
   9. Section 46 33 33 - Polymer Blending and Feed Equipment
   10. Section 46 61 46 - Automatic Backwash Disc Filter

PART 2 - PRODUCTS

2.1 CONSTRUCTION AND MATERIALS

A. General - All wetted elements of the RDT unit shall be fabricated from 304 stainless steel, or equally corrosion-resistant material. This includes the floc development tank, input connection, discharge assembly, and driven impeller; the rotary element composed of the input assembly, the multiple stages of the rotary element, the discharge assembly, the filtration media covering the various stages and all fasteners; the supporting frame assembly, the shower deflection covering and all fasteners; the washing header and fasteners; the return water collection tank, pull cord emergency stop switches, and the integrated central electrical control panel. The principal elements of the rotary sludge thickener are to be fully assembled for simplified movement and installation.

B. Equipment Base - The equipment base shall be of electric weld construction fabricated of ASTM A36 carbon steel C8 X 13.75 or equal structural members with six (6) leg supports with base plates to be provide unobstructed access and drainage below the unit. Exterior surfaces shall be dry, cleaned free of dirt, oil, grease, and mill scale and sandblasted to a near white metal finish. One (1) coat of an epoxy primer shall be applied to the sandblasted surfaces, 1.5 mils DFT. Then two (2) coats of a cross-linked epoxy shall be applied for a black semi-gloss finish. Each coat shall be of minimum 2.0 mils DFT.

C. Floc Development System - The flocculation tank shall be equipped with a 8-inch flanged connection tangential inlet near the bottom and a tangential outlet near the top. The driven impeller of the flocculation system shall be composed of a shaft and a double vertical flat blade on either side of the shaft with a nylon steady bearing centrally located on the bottom of the tank. The discharge flume assembly shall include a step down delivery for the transfer of conditioned sludge to the receiving surface in the first stage of the rotary element. The floc tank shall include a 4” drain connection into the thickener filtrate drain.

D. Rotary System –
   1. The rotary system shall be composed of multiple stages. Each stage, starting with the input stage, shall function in a distinct progression of the intended dewatering program. Each stage shall be covered with stainless steel woven wire mesh selected on the basis of porosity or percent openness, the opening size and the wire diameter used in the weaving process. Each stage wire mesh may vary with each of the other stages, and wire selections will be made on the basis of maximizing flow consistent with the requirements for high quality filtrate.
   2. The woven wire meshes covering each stage shall be easily changed with simple tools. The woven meshes shall be fastened as the outer covering of each stage and shall be flanged to the outer surface of the perforated metal housing surrounding each stage.
   3. Each stage shall be equipped with roll bars, split augers, ports, closures and/or deflectors to influence shear, water release and drainage rate independent of flow. Delivery of output solids shall be by gravity resulting from a series of detention rings, separating the stages, progressively lower in the direction of delivery and influenced by the split augers.
   4. Nominal dimensions for the cylinder diameter shall be 44 inches with a cylinder length of 192.5 inches.
   5. Access doors to the drum shall to include small hinged door panels to provide access for filtrate sampling and cleaning.

E. Drum Drive -
   1. The drum drive shall be by a direct drive assembly.

F. Trunnion Wheels - Each screen assembly shall be provided with six (6) trunnion wheels and trunnion wheel mounting assemblies. Trunnion wheel assemblies will be accurately mounted to the base frame to provide positive horizontal placement of the rotary drum screen assembly.
   1. The trunnion wheels shall be constructed of acetal copolymer with a minimum outside diameter of 8 inches. Brass bushings shall be provided with each trunnion wheel. The bushings shall be designed to receive lubrication through the support shaft.
   2. The support shaft shall be of type 316 stainless steel having a minimum diameter of 1-3/16 inches. Each shaft shall be accurately positioned and secured by the trunnion mounting bracket. The shaft shall be designed to provide center lubrication to the bearing and trunnion wheel. Each shaft shall be provided with an Alemite grease zerk fitting for ease of lubrication.
   3. The trunnion wheel support bracket shall be fabricated of type 304 stainless steel. The bracket assembly shall be formed, stiffener reinforced, accurately fabricated and positioned on the drum frame to support the loads imposed by the rotary drum assembly.

G. The Washing System -
   1. A single self-cleaning washing header shall be oriented in a horizontal position the length of the rotary system to maintain positive cleaning with each revolution of the rotary system, forcing the washed off solids to return to the mass of solids tumbling inside the rotary element.
   2. The washing header shall contain spray tips of varying orifice size to emit a progressively reduced flow of high pressure washing water in the direction of the rotary system delivery end. The washing header shall be mounted with U-bolts permitting the adjustment of the angle of impact of the water, from tangential to square, permitting the restriction of water re-entering the stages to only that quantity required to maintain openness of the filtration woven wire mesh.
   3. Spray header shall be fitted with an Ashcroft stainless steel pressure gauge, liquid filled type 1008S with a 1/4 inch NPT back connection, 2-1/2 inches dial dual scaled at 0/160 psi and 0/1100 kPa.

H. Spray Water Solenoid Valve - The solenoid valve shall be a 1 inch 2-way, pilot operated, brass body valve with NBR seals and discs with a 120 VAC watertight NEMA 4X solenoid enclosure prewired as part of the system skid.

I. Shower Deflection - The rotary element shall be covered on the outside with shower deflection panels designed to contain and fugitive spray and minimize mist emissions. The panels shall overlap and shall be fastened to the framing members of the rotary element. The panels shall be limited in dimension to facilitate removal.

J. Return Water Collection - All elements of the rotary system and supporting frame shall be contained and mounted over the return water or filtrate water collection tank. Delivery of collected filtrate water shall be by gravity through one (1) filtrate tank drain which shall be a 8-inch pipe stub located on the underside of the water collection tank on the unit centerline on the input end of the unit.

K. End Enclosure

1. Each rotary drum thickener shall be provided with an end enclosure to contain discharge sludge mist or spatter. The enclosure shall be fabricated of 14 gauge 304 stainless steel and fitted with doors to allow easy access for thickened sludge inspection and sampling.
2. The end enclosure shall be fitted to a chute for directing the thickened sludge to the sludge pump as shown on the drawings. The chute provided by the thickener manufacturer shall extend downwards to the finished floor elevation and shall include an overflow and dewatered sludge pump flange connections as shown on the drawings.

L. Odor Control Connection - A pipe stub or flanged pipe with sealed cover shall be added to the end enclosure or the shower deflection panel for potential future connection to a future odor control system.

M. Flanged Connections - Flanged connections shall be provided for the influent connection, filtrate water connection and the end enclosure discharge chute connection.

N. Vortex Mixing Valve and Polymer Injection Ring -
1. The RDT shall be provided with a sludge conditioning system designed to efficiently mix polymer with the sludge and to adequately condition the sludge for optimum dewatering. The vortex mixing valve, polymer injection ring, and manifold shall are to be installed by the Contractor.
2. The sludge conditioning system shall be mounted upstream of the thickener and shall consist of an in-line vortex mixer with a variable orifice, polymer injection ring, and polymer solution distribution manifold. The rotary drum thickener manufacturer shall be required to provide to the engineer, a proper layout for the system.
3. Flocculation time shall be adjustable by the displacement of flanged pipe sections (spools) with the sludge conditioning system at a minimum of three (3) locations in the sludge feed piping. The sludge conditioning system will be installed at one of the three (3) locations. Pipe spools of proper size will occupy the remaining two (2) locations.
4. The sludge conditioning system shall meet the following mechanical specifications:
    a. Vortex Mixer - The in-line mixer shall have a flanged housing, an adjustable orifice connected to an externally mounted lever and counterweight and a removable side plate for inspection and cleaning.
    b. The open throat area shall be fully adjustable downward and shall open automatically to prevent clogging.
    c. The position of the counterweight on the externally mounted orifice plate lever shall be fully adjustable, within a 360-degree circle, to allow for adjustment of the mixing energy, regardless of the mounting angle, while the unit is in operation.
5. Polymer Injection Ring: The injection ring shall have four (4) injection points evenly distributed along its circumference for injecting polymer into the sludge flow.
6. Manifold Block: The manifold distribution block shall divide the single polymer solution feed line into four (4) separate flows for connection to the polymer injection ring.

O. Anchors
1. All anchors will be provided by the Contractor.

## 2.2 ELECTRICAL DEVICES AND CONTROLS

A. Electrical Devices - The following electrical devices shall be supplied:

1. Main Unit Drive. Eurodrive 1.0 HP or equal, AC gearmotor rated for severe duty, transmitting power to the sprockets and chain-driven rotary cylinder. The controller shall be a variable frequency drive (VFD) built for 460 Volts/3 Phase/60 Hertz input power.
2. Floc Tank Drive. Eurodrive 0.5 HP or equal, AC gearmotor rated for severe duty flange mounted to the flocculation tank. The controller shall be a variable frequency drive (VFD) built for 460 Volts/3 Phase/60 Hertz input power.
3. High Pressure Booster Pump. A wash water booster pump shall be provided and sized according to the specific unit requirement for pressurized wash water. The pump will be driven by a fixed speed, 460 Volts/3 Phase/60 Hertz/3500 RPM direct coupled to a 2.0 HP TEFC motor.

B. Controls - The following controls will be provided:
   1. A NEMA 4X standard control panel with 3-point latch, suitable for wall or stand mounting, fabricated of type 304 stainless steel containing:
      a. Main disconnect.
      b. Control power indicator light (illuminated on).
      c. On/Off push buttons (illuminated green-on).
         1) RDT Feed Pump #P-501
         2) RDT Feed Pump # P-502
         3) RDT Sludge Pump # P-504
         4) Polymer Supply
         5) Drum drive.
         6) Floc tank agitator drive.
         7) Booster pump drive.
      d. Emergency stop.
      e. VFD Drives.
         1) Drum drive with 10:1 speed potentiometer.
         2) Floc drive with 10:1 speed potentiometer.
      f. Booster pump starter.
      g. Spray water solenoid valve contacts. (Solenoid valve by others.)
      h. Pull cord emergency stop switch contacts.
      i. Internals, including variable frequency drives, to accommodate 460V, 3 Phase incoming power.
      j. Dry contact outputs for RDT Feed Pump # P-510 and RDT Feed Pump #P511 Run commands.
      k. Dry contact outputs for polymer pump Run command.
      l. Dry contact outputs for RDT Sludge Pump P-29 Run command.
      m. 4-20 mA speed reference output for polymer pump.
      n. 4-20 mA speed reference output from the Sludge Magnetic Flow Meter to the RDT Sludge Pumps P-510 and P-511 to the Adjustable Speed Drive (ASD) within the pump control panel to speed up or slow down pumps to maintain a preset flow to the RDT.
      o. Thickened sludge hopper level sensor utilizing a laser level detector.

C. SCADA System Output
   1. The control panel shall be equipped with SCADA signals (dry contacts) wired to terminals located inside the control panel for the following minimum signals:
      a. Floc tank agitator drive Run Condition
      b. Floc tank agitator drive Fail Condition

c. RDT drive Run Condition
d. RDT drive Fail Condition
e. Booster pump Run Condition
f. Booster pump Fail Condition
g. Thickened sludge hopper High Level Condition

2.3 SPARE PARTS

A. The following spare parts will be provided per sludge thickening unit:. If not providing replace with "It is not necessary to provide spare parts with this unit."
   1. One (1) set of six (6) spare brass bushings.

PART 3 EXECUTION

3.1 FACTORY SERVICE

A. Equipment manufacturer will provide factory service during one (1) trip, for two (2) days on site, for inspection of installation, equipment startup and operator training. Equipment startup and training shall be coordinated with the polymer system supplier to ensure polymer system is fully operable at time of startup.

B. After installation and final testing, the manufacturer shall provide written certification to the OWNER/ENGINEER that all equipment is properly installed and that the plant operators have been instructed on proper operation and maintenance procedures. Local manufacturer's representatives are not acceptable to perform these tasks.

3.2 FACTORY ASSEMBLY, TESTING AND INSPECTION

A. The unit will be factory operated and inspected prior to shipment. The Engineer and/or Owner may, at their option and own expense, witness the factory test.

3.3 INSTALLATION, OPERATION AND MAINTENANCE MANUAL

A. In addition to the normal Installation, Operation and Maintenance Manuals required by contract, a spare manual will be shipped with the unit to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user.

END OF SECTION