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SPECIFICATIONS BOOK

WASTEWATER TREATMENT PLANT EXPANSION

FOR

CITY OF FOLKSTON, GEORGIA

August 26, 2024

MES No. 2013-36.1

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GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 COMMENCEMENTS AND PROSECUTION OF WORK

A. Contract time shall begin at which time the Owner will issue a written Notice to Proceed. The Contractor must commence construction within ten (10) days of issuance of a written Notice to Proceed. The Contractor shall maintain sufficient labor and supervision on the job until all items have been completed and the Engineer's Final Certification has been issued.

1.02 COOPERATION

A. The General Contractor and Sub-Contractors shall cooperate with one another and with other Contractors doing related work and shall coordinate their work with the work of other trades and other Contractors so as to facilitate the general progress of the work. Each trade shall afford all other trades and all other Contractors every reasonable opportunity for the installation of their work and for the storage of their materials.

1.03 SANITARY FACILITIES, TEMPORARY

A. Do not allow any sanitary nuisances to be committed in or about work; enforce sanitary regulations of Local and State Health authorities.

1.04 SITE EXAMINATION OF EXISTING CONDITIONS

A. The Contractor, in undertaking the work under this Contract, is assumed to have visited the premises and to have taken into consideration all conditions which might affect his work. No consideration will be given to any claim based on a lack of knowledge of existing conditions, except where the Contract Documents make definite provisions for adjustment of cost or extension of time due to existing conditions that cannot be readily ascertained.

1.05 SPECIFICATIONS EXPLANATION

A. Attention is directed to the fact that the detailed specifications and separate sections may be written in short or abridged form. In regard to every section of the specifications and all parts thereof, mentioned therein or indications on the

drawings or articles, materials, operations, or methods required that the Contractor:

1. Provide each item mentioned and indicated (of quality or subject to qualifications notes).
2. Perform (according to the conditions stated) each operation prescribed.
3. Provide therefore all necessary labor, equipment, and incidentals.

B. Wherever in these specifications or on the drawings the words "directed", "required", "ordered", or words of like import are used, it shall be understood that the directions, requirements, permission, or order of the Engineer is intended; and similar words "approved", "accepted", "satisfactory", or words of like import shall mean approved, acceptable to, or satisfactory to the Engineer.

C. For the convenience of reference and to facilitate the letting of Contracts or Sub-Contracts, these specifications are separated into titled sections. Such separation shall not, however, operate to make the Engineer an arbiter to establish limits to the Contracts between the Contractor and Sub-Contractors, nor shall such operation be interpreted as superseding normal union functions.

D. Notwithstanding the appearance of such language in the various divisions of the specifications as "The Electrical Contractor", "The Roofing Contractor", etc., the Contractor is responsible to the Owner for the entire Contract and the execution of all work referred to in the Contract Documents.

1.06 STANDARD

A. Wherever reference is made to the standard specifications of nationally known organizations and specific articles, sections, divisions, or headings are not given, such specifications shall apply in full. Standard specifications were included herein by abbreviation or otherwise shall form a part of this specification the same as if quoted in full.

B. The Engineer may require, and the Contractor shall furnish if required to do so, certificates from manufacturers to the effect that the products or materials furnished by them for use in the work comply with the applicable specified requirements for the materials or products being furnished.

1.07 TELEPHONE, TEMPORARY

A. Contractor shall provide mobile telephone numbers for the Project Superintendent and Project Foreman either prior to or during the Preconstruction Meeting.

1.08 TEMPORARY UTILITIES

A. Contractor shall furnish water, electricity, and heating fuel necessary for construction. The contractor shall provide necessary temporary piping, faucets, valves, wiring, switches, outlets, etc., to carry services to the work. The Contractor shall make all temporary utility connections for his own use and remove temporary services on completion of the Contract.

1.09 WORK OUTSIDE OF THE PROPERTY LINE

A. All work outside of the property line called for by the Contract Documents shall be performed by the Contractor and all costs for same shall be included in the Contract.

1.10 AS-BUILT DRAWINGS

A. The Contractor shall, upon completion of the work, furnish a marked set of drawings showing field changes affecting the various mechanical trades, utilities, and electrical, as actually installed and as specified under those sections of the specifications, and deliver them to the Engineer. The engineer will furnish prints to the Contractor for marking.

1.11 LIQUIDATED DAMAGES

A. Substantial Completion - If the Contractor neglects, fails, or refuses to achieve Substantial Completion of the work by not later than 12 A.M. (Midnight), the Contractor shall pay to the Owner, Liquidated Damages in the amount of three hundred dollars ($300.00) per calendar day for each and every day that the Contractor is in default after the date indicated on the Notice to Proceed.

B. Final Completion - If the Contractor neglects, fails, or refuses to complete the work by not later than 12 A.M. (Midnight), the Contractor shall pay to the Owner, Liquidated damages, in the amount of three hundred dollars ($300.00) per calendar day for each and every day that the Contractor is in default after the date indicated on the Notice to Proceed. Liquidated Damages for Substantial Completion and Final Completion are cumulative.

1. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such an event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be retained from time to time by

the Owner from current Progress Payment should the construction progress fall behind schedule.

2. Time is of the essence of each and every portion of this Contract and of the specification wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract.

3. Extensions of time apply to Liquidated Damages only and shall be allowed only for conditions over which the Contractor has no control, such as acts of God, transportation strikes affecting the delivery of materials or equipment which are used in the project, manufacturing strikes affecting the production of materials or equipment which are used in the project, and weather above and beyond the normally expected loss of time-based on historical climatological conditions over the last 10 years. For any time requested over what should be expected based on historical climatological conditions the amount of rain or temperature must meet the following conditions. To get credit for delays due to temperature the temperature must be at a level that would prevent construction in accordance with the other sections in these specifications. In order to get credit for a rain delay, the rain event must be persistent for more than four hours during that day and rainfall must be in excess of 0.5” for that 4-hour period or more than 1” during the day.

1.12 MATERIALS PRIOR APPROVAL AND SUBSTITUTIONS

A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model, or catalog number, only such specific item may be used in the base bid, except as hereinafter provided.

B. If Contractors wish to use items of equipment and/or materials other than those specifically identified in the Specifications, Contractor shall apply in writing to the Engineer for approval of substitution at least seven (7) days prior to the opening of bids, submitting with his request for approval complete descriptive and technical data on the item(s) he proposes to furnish.

C. Approved substitutions will be listed in an addendum issued to all General Contractors prior to the opening of bids.

D. Unless requests for changes in the Specifications are approved prior to the opening of bids, as defined above, the successful Contractor will be held to furnish

specified items. After the contract is awarded, changes in specifications will be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT AND MATERIALS

A. After execution of the contract, substitution of equipment and/or materials other than those specifically named in the Contract Documents will be approved by the Engineer for the following reasons only:

1. That the equipment or material is no longer available.
2. That the equipment or material does not perform the function for which it was intended.
3. That the equipment or material cannot be delivered due to conditions beyond the Contractor's control.

B. To receive consideration, requests for substitutions must be in writing accompanied by documentary proof of equality, and difference in price and delivery, if any.

C. In case of a difference in price, the Owner shall receive all benefits of the difference in the cost involved in any substitutions, and the contract altered by change order to credit the Owner with any savings so obtained.

1.14 INSPECTING AND TESTING OF MATERIALS

A. Wherever in these Contract Documents inspecting and testing of material is called for, the selection of bureaus, laboratories, and/or agencies for such inspecting and testing shall be made by the Engineer, and the character of the test shall be stipulated by the Engineer. Documentary evidence satisfactory to the Engineer that the materials have passed the required inspection and tests must be furnished in quadruplicate to the Engineer by the bureau, agency or laboratory selected. Materials satisfactorily meeting the requirements of the inspection or tests shall be approved by the Engineer and the Contractor notified of the results. The cost of such inspecting and testing shall be paid for by the Contractor.

1.15 ON-SITE TESTING AND INSPECTING

A. Wherever in these Contract Documents testing or inspecting is called for, the selection of bureaus, laboratories, and/or agencies for such testing or inspecting shall be made by the Engineer. Documentary evidence satisfactory to the Engineer that the materials have passed the required tests or inspections shall be furnished

in quadruplicate to the Engineer. The cost of such tests and inspections shall be paid for by the Contractor.

1.16 MEASUREMENTS AND DIMENSIONS

A. Before ordering materials or doing work which is dependent on the proper size of installation upon coordination with site conditions, the Contractor shall verify all dimensions by taking measurements at the site and shall be responsible for the correctness of same. No consideration will be given to any claim based on differences between the actual dimensions and those indicated on the drawings. Any discrepancies between the drawings and/or specifications and the existing conditions shall be referred to the Engineer for adjustment before any work affected thereby is begun.

1.17 SHOP DRAWINGS

A. Shop drawings shall be dated and contain: Name of the project; description and names of equipment, materials, and items; and complete identification of locations at which material or equipment is to be installed, reference to the section of the specifications where it is specified and drawings number, where shown. In addition to the above, the Shop drawings shall: (1) show complete information for checking and for fabrication, installation, and erection, without reference to other drawings or notes; (2) shall be of drafting line work and lettering that is easily readable under field conditions; (3) have plane oriented the same as plans on the Contract Drawings; (4) list grade, class, or strength of materials; (5) be checked and initialed by the suppliers drafting room checker; (6) be checked and coordinated with other phases of the work, by a person in the Contractor's employ who is experienced and qualified in the checking and coordination of shop drawings.

1. No exceptions taken. (If checked here, fabrication may be undertaken. Approval does not authorize a change to contract sums unless stated in a separate letter or by change order.)
2. Note markings. (If checked here, fabrication may be undertaken. The contractor is to coordinate markings noted.)
3. Revise and resubmit.
4. Rejected.
5. Engineer review is for conformance with the design concept of the project and compliance with the information given within the Contract Documents only. The Contractor is responsible for dimensions being confirmed and correlated at the site; for information that pertains solely to the fabrication

processes or to means, method, techniques, sequence, and procedures of construction; and for coordination of the work of all trades.

6. Failure to note a noncompliance will not prevent later rejection when the noncompliance is disclosed.

B. Shop drawings shall not, after having been submitted, be later issued with revised or additional materials, except for items corrected during the checking by the Contractor or reviewed by the Engineer.

C. The following notation will be used by the Engineer in his review.

D. Submission of Shop drawings shall be accompanied by a transmittal letter in duplicate, containing the project name, Owner's project number, Contractor's name, and a number of drawings, title, and other pertinent data.

E. The Contractor shall promptly submit to the Engineer, five copies of Architectural items and six copies of Engineering items, required by the Contract Documents in accordance with the aforesaid schedule so as to cause no delay in his work or in the work of any other Contractor.

F. For standard items not requiring special shop drawings for manufacture, submit six copies of the manufacturer's product data showing illustrated cuts of the items to be furnished, scaled details, size dimensions, performance characteristics, capabilities, wiring diagrams, control, and all other pertinent information.

G. The Contractor shall: (1) check, coordinate, correct, stamp, date, and sign all copies of each drawing, and deliver them to the Engineer for his review; (2) identify the set of drawings he has checked; this set shall be shown by checked marks or correction that every item has been verified and with the requirements of the Contract Documents.

1.18 MAINTENANCE MANUAL

A. Contractor shall, prior to completion of the contract, deliver to the Engineer, three copies of the manual, assembled and bound with a hardcover, for the Owner's guidance, full details for care and maintenance of visible surfaces and of equipment included in the contract.

B. Contractor shall, for this manual, obtain from subcontractor, literature of manufacturers relating to equipment, including motors; also furnish cuts, wiring diagrams, control diagrams, instruction sheets, and other information pertaining to same that will be useful to Owner in overall operation and maintenance.

C. Where the above-described manuals and data are called for under separate sections of the specifications, they are to be included in the manual description in this article.

1.19 ELECTRONIC MEDIA

A. Contractor may request an electronic file of construction plans in its native AutoCAD format for convenience during construction. The initial cost for preparation of the file shall be $1,000.00, due prior to receipt of the file. The contractor must subscribe to obtain all updates to the file when and if plans are modified. The cost for each update provided to the Contractor shall be $200.00. Prior to receipt of the file, the Contractor must execute an Indemnification Agreement with P.C. Simonton and Associates, Inc. dba M.E. Sack Engineering. Transmission of the file to, or use by, any third party is prohibited.

END OF SECTION

SECTION 01150
MEASUREMENT AND PAYMENT

PART 1- GENERAL

1.01 QUANTITIES

A. Quantities: Quantities listed in the Proposal are approximate only and are intended to serve as a guide in comparing bids and may be increased or decreased without invalidating the unit price bid.

B. Payment: The contractor shall be paid for actual in-place quantities as determined by the Engineer's field measurements.

C. Discrepancies: In case of discrepancies between the figures shown in the unit prices and totals, the unit prices shall apply, and the totals shall be corrected to agree with the unit price.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified. Manufacturer shall supply detailed storage instructions, as necessary, at the time of shipment. These requirements also apply to any sub suppliers making direct shipments to the Site.

B. Equipment shall be delivered on site. All exposed openings shall be protected to prevent entrance of debris, moisture or water during transportation and storage. Contractor shall unload material and sensitive equipment/material must be store out of the weather.

C. All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

D. Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy storage, and to facilitate eventual installation.

E. Contractor shall guarantee all equipment against faulty assembly, defective workmanship, breakage, or other failure. Materials shall be suitable for service connections. Connections shall be manufactured at standard sizes so that unit can be installed in the field

PART 2 - MEASUREMENT AND PAYMENT

2.01 CLEARING & GRUBBING

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, the removal of all trees, shrubs, and undergrowth that presently exist, preventing the construction of this project. All material removed, including vegetation, roots, and organic mat, shall be removed from the site and disposed of at a permitted site. The contractor shall take special care not to disturb the roots of trees that are marked to remain. Trees to be saved shall be marked and approved by the engineer prior. Trees to be saved shall have the appropriate tree protection installed.

2.02 GRADING

A. Measurement: Measurement will be made on the basis of the percent completion of the item of work. All cut and fill quantities are based on the difference between initial topographic data and proposed contours shown on the plans.

B. Payment: Payment will be made at the price bid for each item. Work shall include all equipment, labor, and material to complete each task. This item will include but is not limited to excavation, material transportation and placement, grading to the lines and grades shown on the plans, compaction, and stabilization.

2.03 DREDGE AND CLEAN EXISTING LAGOON

A. Measurement: Measurement will be made based on the completed item of work. No measurement for partial payment will be made.

B. Payment: Payment will be made based on the lump sum bid. Payment will be made once the task is 100% complete. No partial payment will be made for this task. The price shall include all labor, material and equipment required to complete the task. Work shall include dredging of the existing lagoon, disposal of sludge at a permitted site, any repair of damaged caused during dredging, measuring sludge depth on a 20' grid and presenting information to the engineer prior to dredging operation, final clean-up and disposal of all debris.

2.04 GRANITE ROADWAY BASE

A. Measurement: Measurement shall be made on the basis of the number of square yards of graded aggregate base applied to the parking lot and roadway at the specified thickness, as shown on the construction plans. Irregular areas such as turnouts, filler strips, and intersections will be measured to the closest square yard. Prior to the installation of the asphalt, all areas will be checked for proper thickness.

B. Payment: Payment will be made on the basis of the number of square yards of granite crusher run (graded aggregated) base at the specified thickness applied to the roadway at the unit price stated in the bid. The price shall include all labor, equipment, and material to complete the task. Work shall include, but not be limited to, the furnishing, hauling, placing, and compaction of the crusher run base in order to bring the base to the lines, grades, and cross sections shown on the construction plans or established by the Engineer.

2.05 ROCK DRIVE

A. Measurement: Measurement will be made on the basis of the number of square yards of granulated rock drive in place, in accordance with the construction plans and accepted by the Engineer.

B. Payment: Payment will be made on the basis of the number of square yards of granulated rock drive in place in accordance with the unit price bid as stated in the contract. Work shall include, but is not limited to, the furnishing, hauling, placing and compaction of the granulated rock in order to bring the drive to the grades and cross sections as designated on the construction plans and as determined by the Engineer.

2.06 ASPHALT PAVING

C. Measurement: Measurement will be made on the basis of the number of square yards of asphalt in place, in accordance with the construction plans and accepted by the Engineer.

D. Payment: Payment will be made on the basis of the number of square yards of asphalt in place in accordance with the unit price bid as stated in the contract. Work shall include, but is not limited to, the furnishing, hauling, placing and compaction of the asphalt in order to bring the pavement to the lines, grades and cross sections as designated on the construction plans and as determined by the Engineer. The unit price bid shall also include surface cleaning, prime, and tack.

2.07 GRAVITY SEWER, DRAINAGE PIPE AND STRUCTURES

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, excavation, trenching, necessary shoring and sheeting, dewatering, forming, form wrecking, foundations as required, furnishing and installing the storm drainage structures, manholes, raiser sections, castings, inverts, stub outs, plugs, pipe connections, concrete manhole markers (if applicable), ram-nek, placement of grates, manhole rings and covers as applicable, grouting around pipe, all pipe bedding, furnishing and installing pipe backfill, compaction, grading, complete surface restoration and cleanup.

2.08 ELECTRICAL AND CONTROLS

A. Measurement: Measurement shall be made on the basis of the percent complete of the task in accordance with approved plans and specifications.

B. Payment: Payment will be based on the percent of this task completion at the time of the request based on the price bid. The work shall include equipment, labor, and materials required to complete the task. The task shall include, but is not limited to supplying and installing all electrical materials, sensors, site lighting, conduit, wire, control panels, breakers, fiber, SCADA equipment, handholes, manholes, connection to existing systems, testing, operational start-up, trenching, excavation, backfill, clean up and surface restoration.

2.09 EROSION CONTROL AND GRASSING

A. Measurement: Measurement will be made on the basis of the completed item of work. All silt fence will be measured by the linear foot of the silt fence properly installed and trenched in.

B. Payment: Payment will be made on the basis of the price bid for each item. Work shall include all equipment, material, and labor to complete the installation. This item will include but is not limited to trenching, grading, inlet and outlet protection, furnishing, and installing silt fence; temporary and final stabilization; maintaining erosion and sediment control structures and facilities, and establishing a final stand of cover in accordance with the plans and specifications. Retainage on final grassing will be based on the engineer's estimate of the cost to complete the task, which may not be reflected in the contractor's bid price.

2.10 COMPLETE INFLUENT PUMP STATION

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, excavation, trenching, backfill, shoving, sheeting, dewatering, receiving and installing pumps, miscellaneous hardware, spare parts, aluminum cover, galvanized pre-engineered metal building with hoist beam, supports, instrumentation and process control equipment, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, piping, valves, fittings, conduit, miscellaneous hardware, construction of concrete structure to include all concrete, rebar, framing and finishing, testing, operational setup, general cleanup, and surface restoration.

2.11 COMPLETE HEADWORKS

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, excavation, trenching, backfill, shoving, sheeting, dewatering, receiving, and installing

automated screen filter equipment, screw conveyor, compactor, screen mountings, discharge piping, manual cleaning screen filter equipment, manual rake, biotrickling filter vessel (odor control system), media, irrigation system, dampers, blower, parshall flume, ultrasonic flow meter, spiral separation units, grit airlift units, discharge piping, refrigerated autosampler equipment, miscellaneous hardware, spare parts, instrumentation and process control equipment, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, water and air piping, valves, gates, fittings, conduit, miscellaneous hardware construction of concrete structure to include all concrete, rebar, framing, modification and finishing, concrete pads, testing, operational setup, general cleanup, and surface restoration.

2.12 COMPLETE INLINE PUMP STATION

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, excavation, trenching, backfill, shoving, sheeting, dewatering, receiving and installing pumps, miscellaneous hardware, spare parts, aluminum cover, galvanized pre-engineered metal building with hoist beam, supports, instrumentation and process control equipment, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, piping, valves, fittings, conduit, miscellaneous hardware, construction of concrete structure to include all concrete, rebar, framing and finishing, testing, operational setup, general cleanup, and surface restoration.

2.13 COMPLETE SBR SYSTEM-BASED TREATMENT PLANT

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made on the basis of the percentage completion of the lump sum price stated in the bid. The price bid shall include furnishing all labor, materials, tools, and equipment necessary to complete the task. The task shall include, but is not limited to, excavation, trenching, backfill, shoving, sheeting, dewatering, receiving, and installing SBR system, digester, and post equalization equipment such as, mixers, transfer and sludge pumps, decanter assembly, floating weir, retrievable fine bubble diffuser system, lifting system,

fixed coarse bubble diffuser system; SBR, digester, and post equalization positive displacement blowers, structures, air and water piping, yard piping, appurtenances, chemical metering pump skids, chemical storage tanks, chemical piping, pipe insulation, pipe supports, miscellaneous hardware, spare parts, instrumentation and process control equipment, electrical equipment, walkways, railing, stairs, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, construction of concrete structures, basins and digester tank to include all concrete, rebar, framing, modification and finishing, concrete pads for SBR system and auxiliary equipment such as the emergency power supply and transformer, piping, valves, fittings, conduit, miscellaneous hardware, liner, coating, buildings (dewatering and chemical storage building, blower building, electrical building, and operations building), site development, testing, operational setup, general cleanup, and surface restoration.

2.14 COMPLETE DISK FILTRATION SYSTEM

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, receiving, and installing disk cloth filter, drive assembly, pumps, piping and appurtenances, miscellaneous hardware, spare parts, instrumentation and process control equipment, walkways, stairs, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, construction of concrete structure to include all concrete, rebar, framing, modification and finishing, concrete pads, testing, operational setup, general cleanup, and surface restoration.

2.15 COMPLETE UV DISINFECTION

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, receiving and installing UV lamp modules, electronic ballast, miscellaneous hardware, spare parts, instrumentation and process control equipment, automatic mechanical cleaning system, operations and maintenance manual, and other auxiliaries as

required for proper installation and operation, construction of concrete structure to include all concrete, rebar, framing, modification and finishing, concrete pads, testing, operational setup, general cleanup, and surface restoration.

2.16 COMPLETE RECLAIMED WATER PUMP STATION EQUIPMENT

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, pumps, hydropneumatic tank, piping and appurtenances, miscellaneous hardware, spare parts, aluminum cover, supports, instrumentation and process control equipment, operations and maintenance manual, and other auxiliaries as required for proper installation and operation, piping, valves, fittings, conduit, miscellaneous hardware, construction of concrete structure to include all concrete, rebar, framing and finishing, testing, operational setup, general cleanup, and surface restoration.

2.17 COMPLETE SLUDGE DEWATERING SYSTEM

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, receiving and installing belt filter press equipment, pumps, shaftless screw conveyor equipment, dumpsters, piping and appurtenances, miscellaneous hardware, spare parts, instrumentation and process control equipment, operations and maintenance manual, and other auxiliaries as required for proper installation and operation.

2.18 EMERGENCY POWER SUPPLY

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to

complete this item. Work shall include, but is not limited to, receiving and installing the emergency power supply, air supply/exhaust system, transfer switch, wiring, conduit, miscellaneous hardware, spare parts, instrumentation and control equipment, walkways, stairs, operations and maintenance manual, fuel supply tank, and other auxiliaries as required for proper installation and operation.

2.19 TRANSFORMER

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, receiving and installing electrical transformer, wiring, conduit, overcurrent protection, miscellaneous hardware, spare parts, and other auxiliaries as required for proper installation and operation.

2.20 LABORATORY CASEWORK

A. Measurement: Measurement shall be made on the basis of the percentage completed of the task in accordance with the plans and specifications.

B. Payment: Payment will be made at the lump sum stated in the bid. The price bid shall include furnishing all labor, materials, and equipment necessary to complete this item. Work shall include, but is not limited to, wood cabinets, filler and closure panels, countertops, shelves, sinks, water, gas, and electrical fittings and accessories, miscellaneous hardware, spare parts, instrumentation, operations and maintenance manual, and other auxiliaries as required for proper installation and operation.

2.21 MOBILIZATION

A. Payment: Payment will be made for the price as stated in the Contract once the Contractor has established his construction yard and met the requirements established in the Contract Documents. Mobilization will be recognized as complete once the Contractor has provided a construction schedule and moved his equipment and a substantial amount of material to the job site. Construction must be underway and progressing. Payment for mobilization will be limited to a maximum amount not to exceed 5.0% of the bid price.

END OF SECTION

SECTION 02210
SITE GRADING

PART 1 – GENERAL

1.01 QUALITY ASSURANCE

A. Reference Standards:

1. Standards of American Society for Testing and Materials:

ASTM-D-698 Moisture-Density Relations of Soils Using 5.5 lb. (2.5 KG) Hammer and 12 inch (304.8 mm) Drop

2. Methods of Sampling and Testing of American Association of State Highway and Transportation Officials (AASHTO), latest edition.

1.02 TESTING

A. All soil testing shall be performed by an Independent Testing Laboratory selected by the Engineer and paid for by the Contractor.

1.03 EXCESS EXCAVATED MATERIALS

A. Excess excavated materials shall be wasted off site by the Contractor at no expense to Owner, or as directed by the Engineer.

1.04 BORROW MATERIAL

A. Any borrow material required to accomplish all levels, lines and grades indicated shall be furnished by the Contractor at no expense to the Owner.

B. Borrow material shall be obtained from borrow pits off site.

C. The Contractor shall pay for all soil analysis for borrow material.

1.05 EXCAVATED MATERIAL

A. All material to be excavated shall be classified as earth.

1.06 UNSUITABLE BEARING MATERIALS

A. Should unsuitable bearing materials be encountered at levels indicated and found to have insufficient bearing values the Engineer may order the excavation carried to lower depths.

B. Compensation for the removal and/or replacement of unsuitable materials shall be in accordance with the General Conditions, Article 10.01.

C. Excavation of unsuitable bearing materials shall not proceed until the conditions have been observed by the Engineer and written approval has been given by the Owner.

PART 2 – EXECUTION

2.01 TOP SOIL

A. Areas to be stripped shall first be scraped clean of all brush, weeds, grass, roots and other material.

B. Remove topsoil from areas to be graded and stockpile in locations where it will not interfere with structures, roads or utility operations.

C. Topsoil shall be free from subsoil, debris and stones larger than 2 inches in diameter. The stored topsoil shall be left in piles to be used for finished grading. Contractor shall install a minimum of 4" thick topsoil across pervious areas of the site prior to planting. If topsoil from site is unsuitable or insufficient to achieve 4" thickness, additional material is to be provided by the Contractor at no additional cost to owner and from a source approved by Engineer.

D. Stockpiles shall be protected from contamination by undesirable foreign matter and shall be graded to shed water.

2.02 EXCAVATION

A. Excavations shall be accomplished to bring surface to the levels, lines and grades as indicated.

B. Excavated material to be used for fill or backfill material shall be stockpiled on the site as directed by the Engineer. Stockpiles shall be graded to shed water.

2.03 FILLING

A. All fill material required to bring areas to the levels, lines and grades indicated shall be selected and approved materials from approved borrow areas.

B. Sub-grades on which fill material is to be placed shall be scarified to a depth of not less than 4 inches by plowing or discing. A layer of suitable fill material, approximately 3 inches in depth, shall be spread over the scarified surface and compacted.

C. Fill material shall be spread and compacted in successive uniform layers not exceeding 8 inches in depth (loose measure) until the total thickness of fill is completed.

2.04 COMPACTION

A. Compaction required for material fill shall be 95% of Standard Proctor, maximum dry density as determined by the procedures of ASTM D-698. Fill areas shall be crowned and sloped to drainage ditches or as required to prevent ponding of surface water.

B. Compaction by flooding of any material is not acceptable. In the event that any flooding takes place, the material and all adjacent softened material shall be removed and replaced with compacted fill at no cost to the Owner.

2.05 FINISH GRADE

A. Distribute topsoil evenly to levels, lines and grades shown.

B. Finish grade to be trimmed and raked true to line and grade to avoid surface ponding.

C. Remove stone two inches or greater in diameter and debris from soil.

D. Finish grade tolerance to +/- 0.05 foot for roadways and +/- 0.10 foot for other areas.

END OF SECTION

SECTION 02221
TRENCH EXCAVATION, BACKFILL, AND COMPACTION

PART 1 – GENERAL

1.01 SCOPE, STANDARDS & DEFINITIONS

A. Work under this section shall consist of furnishing all materials, equipment and labor for excavation, trenching and backfilling for utility systems. "Utility systems" shall include underground piping and appurtenances for water distribution systems, storm water drains, sewage collection systems, force mains, spray irrigation system and all other pipes and appurtenances shown on the drawings.

B. Applicable Standards and Reference

I. ASTM D2321 Soil Classification and Restrictions

a. Class IA = Manufactured crushed stone, shell, crushed slag or rock, open graded, clean, large voids, contains no fines, can allow sand migration to create excessive settling. Suitable as drainage blanket.
b. Class IB = Manufactured aggregate dense graded, clean, crushed stone with sand and gradation present. Closer void so little migration of sand, little fines. Minimal migration of sand. Suitable as drainage blanket.
c. Class II = Coarse grained soils and sand, graded gravel and sandy mix, minimal migration of silt or sand, Use as drainage blanket and drains limited.
d. Class III = Coarse grain sand with fines, silty gravel, gravel-sand-silt mixture, clayey gravels, silty sand mixture. Not to be used in the presence of water.
e. Class IVA = Fine grain soils, inorganic, Inorganic silts and very fine sand, silty clayey fine sands, inorganic clay with minor plasticity, lean clay. Use only where no water exists and shallow fills.
f. Class IVB = Fine Grained soils inorganic, micaceous fine sand, silty soil, fat clay, clay with high plasticity. Use requires geotechnical evaluation.
g. Class V = Organic soils, clay and silt with organics. No permitted use other than top 6” outside roadways for soil amendment for grassing.

1.02 EXISTING UTILITIES

A. Before opening trenches, the Contractor shall examine all available records and explore for the location of all sub-surface pipes, valves or other structures and reference such locations on the surface.

B. In opening trenches, every effort shall be made not to interfere with these utilities structures. Expose existing piping by hand before excavating by machine. Excavate existing utilities sufficiently in advance of pipe laying to determine crossing arrangement. Slight deviations may be permitted in order to clear such structures. The Contractor shall be entirely responsible for the preservation of all underground or overhead utility lines and structures, such as gas, water, sewer lines, telephone conduit, power lines, etc., and shall replace, adjust or repair, without additional compensation, any such lines damaged or interfered with as a result of this construction.

C. Schedule work to keep roads and utilities in usable condition; coordinating all operation with the Owner to avoid inconvenience insofar as practicable.

1.03 EXCAVATED MATERIAL

A. All material to be excavated shall be classified as earth.

1.04 BORROW MATERIAL

A. Any borrow material required to accomplish all levels, lines and grades indicated shall be furnished by the Contractor at no expense to the Owner.

B. Borrow material shall be obtained from borrow pits off site.

C. The Contractor shall pay for all soils analysis for borrow material.

1.05 TESTING

A. All soil testing shall be performed by an Independent Testing Laboratory selected by the Engineer and paid for by the Contractor.

1.06 QUALITY ASSURANCE

A. All excavation within the rights of way of city streets and county, State or Federal roadways, shall be backfilled in accordance with the then prevailing requirements of the Georgia Department of Transportation, Highway Division.

B. Reference Standards: Methods of Sampling and Testing of American Association of State Highway and Transportation Officials (AASHTO).

PART 2 – EXECUTION

2.01 GENERAL EXCAVATION

A. The Contractor shall do all excavation of whatever substances encountered to depth shown on plans. Excavated materials not required for fill or backfill shall be removed from site as directed by the Engineer.

B. Contractor is to excavate to provide 3 foot minimum cover over utility.

C. Excavation for manholes and other accessories to have 12 inches minimum and 24 inch maximum clearance on all sides.

D. Excavation shall not be carried below the required level.

E. Where excavation is carried below grades indicated, the Contractor shall refill same to the proper grade with compacted earth or stone, or as directed by the Engineer.

F. Banks of trenches shall be vertical.

G. Width of trench shall be as shown on the plans. The bottom of trench for sewers and culverts shall be rounded so that an arc of the circumference equal to 0.6 of the outside diameter of the pipe rests on undisturbed soil.

H. Bell holes shall be excavated accurately to size by hand.

2.02 UNSUITABLE BEARING MATERIALS

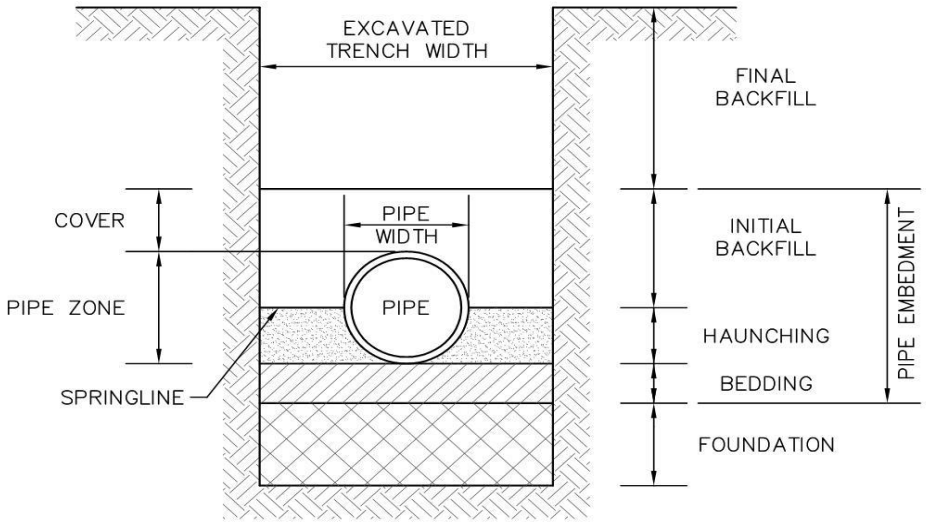
A. Should unsuitable bearing materials be encountered at levels indicated and found to have insufficient bearing values the Engineer may order the excavation carried to lower depth.

B. Compensation for the removal and/or replacement of unsuitable bearing materials shall be in accordance ASTM D2321 requirements.

C. Excavation of unsuitable bearing materials shall not proceed until the conditions have been observed by the Engineer and written approval is given by the Owner.

2.03 PIPE BEDDING

A. The following detail provides trench & pipe zone terminology.



PIPE BEDDING DETAIL
N.T.S.

B. The trench floor should be constructed to provide firm, stable, and uniform support for the full length of the pipe. This can be accomplished by bringing the entire trench floor level grade and then creating bell holes at each joint to permit proper joint assembly, alignment and support. Portions of the trench that are excavated below grade should be returned to grade and compacted as required to provide proper support. If native trench soil is not suitable for pipe bedding, the trench should be over excavated and refilled with suitable foundation material either local sandy material compacted to 90% Std. Proctor or #57 stone depending on the presence of water and, as approved by the engineer. Bedding material shall be Class IB or II as defined in ASTM D2321. Large rocks or hard material should not be contained in the bedding area (minimum of 6") below the pipe.

C. The most important factor in assuring proper pipe-soil interaction is the haunching material and its density. This material provides the majority of the support that the pipe requires to function properly in regards to deflection and performance. The

haunching material shall be placed and compacted under the pipe haunches as shown in the detail above. Proper control should be exercised to avoid deflecting the pipe from proper alignment. The same material that is used for bedding should be used for haunching and compacted to the same standards. Haunching material shall be Class IB or II as defined in ASTM D2321.

D. Initial backfill, as shown in the detail above, shall be accomplished with suitable, compactable material and compacted in 6" layers. Material shall meet the requirements of Class Ib, II or III as restricted in ASTM D2321.

E. Final Backfill will be accomplished by placing material in 12" lifts and compacting to a level determined by the final use of the area above the pipe. Final backfill in roadways shall require placement of suitable Class IA, IB, II and III backfill material, placed in 12" lifts and compacted to 100% standard proctor (ASTM Test D-698). Final Backfill outside of roadways shall be Class II, III or IVA and lightly compacted to avoid settling in the future. The top 6" of the final backfill, outside of roadways, shall be suitable for establishing a final grassed surface.

F. Material used in the "trench & pipe zone" shall be restricted as per the limitations and restrictions as outlined in ASTM D2321

2.04 BRACING AND SHORING

A. The Contractor shall do all bracing, sheeting and shoring necessary to perform and protect all excavations as required for safety.

B. Sheeting driven alongside the pipe should be cut off and left in place to an elevation 1.5 feet above the top of the pipe.

C. All other sheeting shall be removed as directed by the Engineer.

2.05 DEWATERING FOR EXCAVATION

A. The Contractor shall pump or remove any water accumulated in any excavated area and shall perform all work necessary to keep excavations clear of water while foundations, structures or any masonry are being constructed or while pipe is being laid.

B. No structure or pipe shall be laid in water, and water shall not be allowed to flow over or rise upon any concrete or masonry or piping until same has been inspected and the mortar or joint material has cured.

C. No extra compensation will be allowed for removal of water.

D. All water pumped or bailed from the trenches or other excavation shall be conveyed to a point of discharge where it will neither cause a hazard to the public health, nor damage to the public or private property, or to work completed or in progress.

2.06 BACKFILL

A. The soil at the sides of a pipe and above it is the backfill.

B. Prior to backfilling any excavation, all piping and structures shall be observed by the Engineer.

C. After pipes have been tested and approved, backfilling shall be done with approved material free from large clods or stones.

D. Backfill shall be placed in uniform layers, four inches thick, on both sides of the pipe and thoroughly compacted with pneumatic or hand tampers. The backfill shall be brought up uniformly on both sides of the pipe and compacted to an elevation of one foot above the top of the pipe, after which the fill shall be placed in eight inch lifts. No rock will be allowed in the backfill within a distance of one foot from the pipe, and rock larger than six inches in the greatest dimension will not be permitted in any part of the trench or backfill.

1. Backfill shall be compacted to not less than 95% of the maximum dry weight per cubic foot as determined by AASHTO Method T-99 (Standard Proctor Test).

2. The top 18 inches of backfill under any paved area shall be compacted to 100% Standard Proctor.

3. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandy soils.

2.07 REPLACING PAVEMENTS

A. Subgrades shall be compacted with a mechanical tamper.

B. The minimum width of replaced concrete pavements shall be 4 feet at interiors and 6 feet at joints and constructed as shown on Standard Details. Avoid cutting pavements at joints; if unavoidable, reconstruct same as original joint. Depth shall be equal to the original thickness. Existing pavements edges shall be cut vertical.

C. Use high-early-strength cement if road is to be opened in less than 3 days.

D. The minimum width of replaced bituminous pavements shall be 3 feet with 8 inch concrete patch. The existing pavement shall be cut vertically and horizontally to a straight line. The 8 inch concrete patch shall be minimum 3,000 psi concrete containing black dye and shall be flush with the existing pavement.

END OF SECTION

SECTION 02415
SITE DEMOLITION

PART 1 GENERAL

1.01 DESCRIPTION

This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures, and debris from trash dumps shown.

1.02 RELATED WORK

A. Demolition and removal of roads, walks, curbs, and on grade slabs outside buildings to be demolished.

B. Safety Requirements: GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

D. Reserved items that are to remain the property of the Owner.

E. Asbestos Removal: See Hazardous Material Sections of General Conditions.

F. Lead Paint: See Hazardous Material Sections of General Conditions.

G. Environmental Protection: See Erosion and Sedimentation Control Specification.

H. Construction Waste Management: See General Requirements Specification.

1.03 PROTECTION

A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of GENERAL CONDITIONS Article, ACCIDENT PREVENTION.

B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.

C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

D. Provide enclosed dust chutes with control gates from each floor to carry debris to truck beds and govern flow of material into truck. Provide overhead bridges of tight board or prefabricated metal construction at dust chutes to protect persons and property from falling debris.

E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

F. In addition to previously listed fire and safety rules to be observed in performance of work, include following:

1. No wall or part of wall shall be permitted to fall outwardly from structures.

2. Maintain at least one stairway in each structure in usable condition to highest remaining floor. Keep stairway free of obstructions and debris until that level of structure has been removed.

3. Wherever a cutting torch or other equipment that might cause a fire is used, provide, and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.

4. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.

G. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Owner; any damaged items shall be repaired or replaced as approved by the Resident Engineer.

The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have Resident Engineer’s approval.

H. The work shall comply with the requirements of the Erosion and Sediment Control Specification and other sections of this specification.

I. The work shall comply with the requirements of GENERAL REQUIREMENTS.

1.04 UTILITY SERVICES

A. Demolish and remove outside utility service lines shown to be removed.

B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - EXECUTION

2.01 DEMOLITION

A. Completely demolish and remove buildings and structures, including all appurtenances related or connected thereto, as noted below:

1. In accordance with Building Demolition Specification.

2. As required for installation of new utility service lines.

3. To full depth within an area defined by hypothetical lines located 1500 mm (5 feet) outside building lines of new structures.

B. Debris, including brick, concrete, stone, metals, and similar materials shall become property of Contractor and shall be disposed of by him daily, off the project site to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Resident Engineer. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state, or local permits, rules and/or regulations.

C. Remove and legally dispose of all materials, other than earth to remain as part of project work, from any trash dumps shown. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations to a permitted site. All materials in the indicated trash dump areas, including above surrounding grade and extending to a depth of 1500mm (5feet) below surrounding grade, shall be included as part of the lump sum compensation for the work of this section. Materials that are located beneath the surface of the surrounding ground more than 1500 mm (5 feet), or materials that are discovered to be hazardous, shall be handled as unforeseen. The removal of hazardous material shall be referred to Hazardous Materials specifications.

E. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Resident Engineer. When Utility lines are encountered that are not indicated on the drawings, the Resident Engineer shall be notified prior to further work in that area.

2.02 CLEAN UP

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to Resident Engineer. Clean up shall include off the off-site disposal of all items and materials not required to remain property of the Owner as well as all debris and rubbish resulting from demolition operations.

END OF SECTION

SECTION 02520
STORM DRAINAGE AND APPURTENANCES

PART 1 – GENERAL

1.01 APPLICABLE STANDARDS

A. Appurtenances shall be constructed in accordance with the referenced Georgia Department of Transportation Standard Drawings.

B. American Society for Testing and Materials (ASTM):

C- 32 Specification for Sewer and Manhole Brick.

C- 76 Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

C-144 Aggregate for Masonry Mortar.

C-270 Mortar for Unit Masonry

C-443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

C-913 Specification for Precast Concrete Water and Wastewater Structures

C-536 Test for Continuity of Coatings in Glassed Steel Equipment by Electrical Testing.

C. Only reinforced concrete pipe will be allowed under roadways or frequently traveled areas.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Roadway Storm Drainage Pipe: Pipe shall be reinforced Concrete Pipe which conforms to ASTM Specification C-76 and shall be of sizes shown. Pipe shall be Class III minimum and as indicated on GA. D.O.T. Standard 1030 D.

B. Non Roadway Storm Drainage Pipe: Pipe shall be one of the following:

1. Corrugated metal pipe shall conform to AASHTO designation M-36, AREA Manual 1-4 requirements for corrugated metal culverts, or Federal Specification QQ-C- 806, with the following applicable requirements:

   a. The outside and inside surfaces of the corrugated metal pipe shall be completely coated with bituminous material with a minimum thickness of 0.05 inch at the crest of the corrugations. Immediately prior to the application of the bituminous coating, the corrugated metal pipe shall be cleaned of all dirt, grease, mill scale, or loose rust and shall be dry.

   b. The outside and inside surfaces of the corrugated metal pipe shall be completely coated with a pure aluminum coating metallurgically bonded by an alloy layer between the steel and the aluminum. The coating shall be applied at a minimum of 1 oz./sq.ft., 2 mils. each side. The weight of aluminum (total both sides) shall be as follows: Minimum check limit triple-spot test=1.00 oz/sq feet, minimum check limit single-spot test=0.90 oz/sq feet. The aluminized steel pipe shall be Armco Aluminized Steel Type 2 or equal.

   c. All rivets shall be placed in the inside valley of the corrugations. The interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs, where used, shall be so placed as to facilitate moving the pipe without damage to the exterior or interior coating. All lateral pipe shall be sixteen (16) gauge. All pipe under possible traffic areas will be twelve (12) or fourteen (14) gauge as indicated.

   d. To facilitate field jointing, the ends of pipes with helical corrugations shall be rerolled to form circumferential corrugations from the end. The diameter of the reformed ends shall not exceed that of the pipe barrel by more than the depth of the corrugation.

2. Polyvinyl chloride (PVC) pipe shall be manufactured and tested in accordance with specification for "Poly (Vinyl Chloride) PVC Large Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter." The pipe and fittings shall be made of PVC plastic and shall have a smooth (not ribbed or corrugated) inside surface.

   a. All pipe shall be bell and spigot. The bell shall consist of an integral wall section or an internal plastic sleeve. The solid cross section rubber ring shall be factory assembled on the spigot. Size and dimensions shall be as shown on the plans. Standard laying length shall be 13 feet ±1 inch.

b. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe.

c. Pipes shall be designed to pass all tests described herein at 73° F (± 3° F).

d. The pipe stiffness shall equal or exceed 10 psi when tested in accordance with ASTM D 2412.

3. High density Polyethylene (HDPE) pipe shall be manufactured for use in nonpressure storm sewer. The pipe shall be manufactured to meet AASHTO M294, Type 'S' for 12" through 36" and AASHTO MP6-96, Type 'S' OR 'D' for 42" and 48" pipe. The pipe and fittings shall be made from HDPE material and shall have a smooth (not ribbed or corrugated) inside surface.

   a. All pipe shall be bell and spigot. The bell shall be an integral part of the pipe. The joint shall use a gasket to form a water tight connection meeting ASTM D3212. Gaskets shall be installed in the bell or in the spigot by the manufacturer. The use of Silt tight fittings may be requested in lieu of water tight connection if approved by the engineer.

   b. All fittings shall conform to AASHTO M294 or MP6-95. Fabricated fittings shall be welded on the interior and exterior at all junctions.

   c. Pipe and fittings material shall be high-density polyethylene meeting ASTM D3350.

   d. Installation shall be in accordance with ASTM D2321.

   e. Pipe may be Advanced Drainage System, Inc., N-12 or N-12 HC or Hancor Sure Lok 10-8 pipe.

   f. HDPE end sections are NOT allowed.

C. Pipe Joints:

1. Joints for concrete pipe shall be one of the following types:

   a. Bell and spigot with rubber gaskets.
   b. Tongue and groove with rubber gaskets.
   c. Tongue and groove with preformed plastic gaskets.

2. Rubber Gaskets shall conform to ASTM Specification C443. Only a neutral agent shall be used as a lubricant. Preformed Plastic Gaskets shall conform to Federal Specification SS-S210, Type I-rope form.

3. Field joints of corrugated steel pipe shall maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation. Circumferential and longitudinal strength shall be provided in accordance with the structural joint performance criteria of Division 2, Section 23 of the AASHTO standard specification for Highway Bridges. The bands shall be constructed in such a manner that will effectively engage the pipe ends. Coupling bands shall not be more than 3 nominal sheet thicknesses lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inches. Bolts and nuts for coupling bands shall conform to the requirements of ASTM Designation: A307.

   Bands shall be furnished to lock with the circumferential corrugations, including rerolled end helical pipe. The corrugated bands shall be not less than 7 inches wide for diameter 4 to 36 inches, inclusive, and not less than 10 1/2 inches wide for all other pipe diameters.

   NO DIMPLE BANDS WILL BE ALLOWED.

4. Joints for PVC pipe must be an integral bell gasketed joint which forms a silt tight joint.

D. Precast Concrete Manhole Sections:

   ASTM C913, except that spacing of manhole steps or ladder rungs shall not exceed 12 inches.

E. Masonry Manholes: Shall be constructed of the following materials:

   1. Brick: ASTM C32, Grade MS
   2. Mortar of Masonry: ASTM C279, Type M.
   3. Aggregate for Masonry Mortar: ASTM C144.
   4. Water for Masonry Mortar shall be fresh, clean and potable.

F. METALS

1. Frames, Covers, and Grating: Frames, covers, and grating shall conform to AASHTO M-306-07 and shall be of grey iron castings.

2. Manhole Steps: Manhole steps shall be constructed of a number of 3 reinforcing bar encapsulated in polypropylene plastic with a non-skid tread. Finished dimensions of the steps shall be identical to that of malleable iron manhole steps. Steps to have a minimum tread width of 12 inches.

2.02 DELIVERY AND STORAGE

A. Storm Drainage Pipe: Care shall be exercised in loading and unloading pipe, fittings, specials and castings at all times in order to avoid shock and damage to the materials. Lifting shall be by hoist or by rolling on skids. Dropping will not be permitted. The Contractor shall be responsible for the safe handling of all materials and no damaged materials shall be used in the work. Materials shall be inspected upon arrival at the site, and any damaged or defective materials shall be immediately removed from the site. All materials shall be stored above grade.

B. Cementious Materials: Cementious materials in bags shall be stored in enclosed structures; floors shall be elevated above the ground a distance sufficient to prevent the absorption of moisture.

C. Metal Items: Metal items, including reinforcing steel, shall be stored above grade in a manner which will not cause excessive rusting or coating with grease or other objectionable materials.

D. PVC Pipe: PVC pipe shall be stored protected from sun light by means of covering the pipe or storing inside a building or under a covered shed. Any pipe showing signs of prolonged outside storage (i.e. faded exterior color or signs of drying) shall be rejected.

E. Aggregates: Aggregates shall be stored on areas to prevent the inclusion of foreign material. Aggregates of different sizes shall be stored in separate piles. Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding 4 feet in depth to minimize segregation. Should the coarse aggregate become segregated, it shall be remixed to conform to the grading requirements.

F. Brick, Concrete Masonry Units and Precast Concrete Manholes: Brick, concrete masonry units and precast concrete manholes shall be handled with care to avoid chipping and breakage, and shall be stored to protect them from contact with the earth and exposure

to the weather, and shall be kept dry until used. Masonry units or precast concrete containing frost or ice shall not be used.

PART 3 – EXECUTION

3.01 DRAINAGE PIPE

A. Each section of pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used.

B. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Pipe shall be laid true to line and grades indicated and shall rest upon the pipe bed for the full length of each section. Runs of pipe shall be laid with outside bells or grooved ends up-grade beginning at the lower end of the pipe line. Pipe having its grade and/or joint disturbed after laying shall be removed, cleaned, and relayed.

C. When pipes are protected by head walls or connect with drainage structures, the exposed ends of the pipe shall be placed or cut flush with the inside face of the structure. After the pipe is cut the rough edges shall be smoothed up in an approved manner. All pipe shall be laid so that markings are on top and the inner surfaces abut neatly, tightly and smoothly.

D. All pipe in place shall be observed by the Engineer before being covered and concealed unless this requirement is waived by the City Inspector and the Design Engineer. Contractor shall clear all pipe of silt debris prior to final acceptance.

3.02 CORRUGATED METAL PIPE JOINTS

A. Corrugated metal pipe shall be butted to form a smooth joint; the space between the pipe and coupling bands shall be kept free from dirt and grit so that the corrugations fit snugly. The coupling band while being tightened shall be tapped with a soft head mallet of wood, rubber or plastic to take up slack and insure a tight joint. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous cement. Pipe on which the asphalt coating has been damaged to such extent that satisfactory field repairs cannot be made will be replaced.

3.03 CONCRETE PIPE JOINT

A. Joint installation shall be in accordance with the recommendations of the manufacturer of the joint material. Surfaces to receive lubricants, cements or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust and other deletious agents at all times. Gaskets and jointing materials shall be inspected before installation of the pipe, and any loose or improperly affixed gaskets and jointing materials shall be removed and replaced.

B. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when the joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

3.04 MASONRY WORK

A. Mortar for Masonry: Mortar for brick masonry, rubble stone masonry, and for bedding cast iron frames in masonry shall be Type M, conforming to ASTM C270.

B. Mortar for pargetting Masonry Walls: Mortar for pargetting masonry walls below grade shall be Type M, conforming to ASTM C270.

C. Brickwork: Brick in circular walls shall be laid in all header courses to form full and close mortar joints, ends and sides in one operation. Vertical joints shall be radial from the center. Brickwork around pipe inlets and outlets shall not be allowed. Gaps shall be poured with concrete.

D. Masonry Structures: Masonry structure walls shall be constructed of brick, concrete masonry units or precast concrete structural sections.

3.05 PRECAST CONCRETE

A. Walls shall be constructed on a footing of cast-in-place concrete, except that precast concrete base sections may be used for precast concrete structure risers. Precast base sections shall conform to the applicable requirements for precast risers and tops in ASTM C913. Mortar that has hardened to the extent that it cannot be made workable without the addition of water shall not be used. Thickness of parget shall be not less than 1/2 inch. No pargetting will be permitted on the inside of structures. Pargetting will not be required for precast concrete structures. Joint work inside masonry structures shall be smooth.

B. One course of brick work is allowed for leveling and adjustment. All other adjustments must be poured in place concrete with a maximum height of 24 inches.

C. For single and double wing catch basins a concrete pad shall be poured 4 inches thick with a minimum slope of 1” per foot away from the curb and gutter and towards the box.

3.06 METAL WORK

A. Iron and steel shall be formed to shape and size with sharp lines and angles. Shearing and punching shall produce clean true lines and surfaces. Casting shall be sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp well defined lines and arises. The necessary rivets, lugs, and brackets shall be provided.

3.07 FIELD TEST

A. A light held in a drainage structure shall show a practically full circle of light through the pipe when viewed from the adjoining end of the line.

B. Lines under pavements shall be tested for infiltration by means of a suitable weir or other measurement device as directed by the Owner. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be applied by filling with water so that the hydraulic head will be at least 6 inches above the crown of the upper end and of the section being tested. The amount of leakage (infiltration or exfiltration) shall not exceed 100 gallons per inch of diameter per day per mile of pipe.

END OF SECTION

SECTION 02540
EROSION CONTROL

PART 1 – GENERAL

1.01 The work specified in this Section consists of furnishing, installing and maintaining temporary erosion controls and temporary sedimentation controls.

1.02 DEFINITIONS

A. Temporary erosion controls shall include grassing, mulching, watering and reseeding on-site sloped surfaces, providing berms at the top of the slopes and providing interceptor ditches at the ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or minimized.

B. Temporary sedimentation controls shall include silt dams, traps, barriers and appurtenances at the toe slopes.

PART 2 – MATERIALS

2.01 Hay bales shall be clean, seed free cereal hay type, securely bound.

2.02 Netting shall be 1/2 inch, galvanized steel chicken wire mesh.

2.03 Filter stone shall be crushed stone conforming to the Department of Transportation - State of Georgia-Standard Specifications – Construction of Transportation Systems - 2013 - Table 800.01, Size Number 3.

2.04 Rolled Erosion Control Products:

A. Mulch Control Netting. A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion product anchor loose fiber mulches
Max. Gradient = 5:1 (H:V) in slope application
C Factor = $\leq$0.10 @ 5:1 in slope application
Max Shear stress 0.25 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 5 lbs/ft
Min Tensile Strength extended term ((24 mo) = 25 lbs/ft

B. Open Weave textile. A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.

Max. Gradient = 3:1 (H:V) in slope application
C Factor = ≤0.15 @ 3:1 in slope application
Max Shear stress = 1.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 50 lbs/ft
Min Tensile Strength extended term ((24 mo) = 100lbs/ft

C. Erosion Control Blanket. A temporary degradable rolled erosion control product composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.

Netless Rolled Erosion Control Blankets:
Max. Gradient = 4:1 (H:V) in slope application
C Factor = ≤0.10 @ 4:1 in slope application
Max Shear stress = 0.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 5 lbs/ft

Single-net Erosion Control Blankets:
Max. Gradient = 3:1 (H:V) in slope application
C Factor = ≤0.15 @ 3:1 in slope application
Max Shear stress = 1.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 50 lbs/ft
Min Tensile Strength extended term ((24 mo) = 100lbs/ft

Double-net Erosion Control Blankets:
Max. Gradient = 2:1 (H:V) in slope application
C Factor = ≤0.2 @ 2:1 in slope application
Max Shear stress = 1.75 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 75 lbs/ft

D. Turf Reinforcement Mat. A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh,and/or other elements, processed into a permanent, three dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long term functionality by permanently reinforcing vegetation during and after maturation. These products are typically used in hydraulic applications such as high flow ditches, channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation.
Slope Application max gradient = 0.5:1 (H:V)
Channel Application Max Shear Stress: 5A, B,C as defined in FHWA guidelines
5A = 6.0 lb/sf, 5B = 8.0 lb/sf, 5C = 10.0 lbs/sf

Min. Tensile Strength: 5A, B,C as defined in FHWA guidelines
5A = 125.0 lb/ft, 5B = 150.0 lb/ft, 5C = 175.0 lbs/ft
5A, B,C as defined in FHWA guidelines

PART 3 – EXECUTION

3.01 SEDIMENTATION CONTROL

A. Silt dams, traps, barriers, and appurtenances shall be installed and shall be maintained in-place for duration of construction.

B. Hay bales shall be staked with two (2) 1 x 4 wood stakes per bale driven eighteen (18) inches into the ground and finishing flush with the top of the bale.

1. Install two (2) stakes per bale with the long dimension of the stakes parallel to the long dimension of the bale.

2. Where bales are installed in multiple layers the bales shall be installed with vertical joints staggered and two (2) 1 x 4 wood stakes per bale driven through all layers, full from top of bale to eighteen inches into the ground.

C. Hay bales which have deteriorated shall be replaced with new materials.

D. Erosion and sedimentation controls shall be maintained in a condition which will retain unfiltered water.

E. The Contractor shall construct the sedimentation ponds and control devices prior to clearing and grubbing the site to insure complete silt control. When the silt or the debris level is greater than 1 foot above the bottom of the pond, the Contractor shall remove the silt or debris to restore the proper elevation for the bottom of the pond.

F. The Contractor shall have all erosion and sedimentation control devices in service and operating properly prior to completion and final acceptance of the contract.

G. Two widths of silt fence are available, Type A or C (36” height) and Type B (22” height). In order to determine which to use, the project duration, slope gradient, and slope length must be known (See Table 6-13.1 below). Approved silt fence fabrics are listed in the Georgia Department of Transportation list #36. The manufacturer shall have either an approved color mark yarn in the fabric or label the fabricated silt fence with both the manufacturer and fabric name every 100 feet.

TABLE 6-13.1

Land Slope	**Maximum Slope Length Behind Fence**
Percent	feet
<2	100
2 to 5	75
5 to 10	50
10 to 20	25
>20	15

All silt fence must meet the minimum standards set forth in Section 171- temporary Silt Fence, of the Department of Transportation, State of Georgia, Standard specification, current edition. See Table 6-13.5 for current Georgia DOT silt fence specifications.

3.02 EROSION CONTROL BALNKET INSTALLATION

A. Prepare a stable and firm soil surface free of rocks and debris. Apply soil amendments as necessary to prepare seedbed. Place fertilizer, water, seed in accordance with manufacture and specification recommendations. Unroll parallel to the primary direction of flow. Ensure that the product maintains intimate contact with the soil over the entire installation. Do not stretch or alow material to bridge over the surface. Staple/stake blanket to soil such that each staple/stake is flush with the underlying soil. Install anchor trenches, seams and terminal ends as specified.

B. The Upslope Trench, Seams and Terminal Ends may be secure by anchor trench, checks, slots or staples as outlined in Erosion Control technology Council (ECTC) standards for upslope security.

C. Staple installation shall be at a rate of 1.7 staples per square yard minimum. Sandy or silty soils may require more. Wet installations may require a more density securing.

D. If seaming method is used seams shall overlap at least 4” and staples must be placed at sufficient spacing to avoid separation.

E. Staples must be placed at 4”x 4” spacing on check slots and check seams.

F. Consecutive rolls shall have overlaps of at least 6” and secured with staples every 1 foot.

3.03 RESPONSIBILITY

A. The Contractor shall be solely responsible for insuring that no silt or debris leaves the immediate construction site. Any silt or debris that does leave the immediate site shall be cleaned up and the area disturbed shall be returned to its natural state as directed by the Engineer at the Contractor's expense.

B. The Contractor has the option to submit additional control measures in the form of shop drawings.

END OF SECTION

SECTION 02555
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.01 GENERAL

Water distribution systems shall be designed to sustain EPD's standards for safe drinking water quality. Special consideration should be given to distribution main sizing, providing for design of multidirectional flow, adequate valving for distribution system control, and provisions for adequate flushing. Distribution systems should be designed to maximize turnover and to minimize residence times while delivering acceptable pressures and flows.

1.02 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C151	Ductile-Iron Pipe, Centrifugally Cast
C300	Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
C500	Gate Valves 3" 48" for Water and Other Liquids
C502	Dry Barrel Fire Hydrants
C600	Installation of Cast Iron Water Mains
C651	Disinfecting Water Mains
C800	Threads for Underground Service Line Fittings
C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. - 60 In.

B. American National Standards Institute (ANSI):

A 21.10	Gray Iron and Ductile Iron Fittings, 2" 48" for Water and Other liquids
A 21.11	Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe Fittings
A 21.4	Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water
A 21.51	Ductile Iron Pipe, Centrifugally Cast in Metal or Sand Lined Molds, for Water or Other Liquids
B 18.2	Square and Hex Head Bolts and Screws

C. American Society of Testing and Materials (ASTM):

A 47	Malleable Iron Castings
A 48	Gray Iron Casting
A 88	Seamless Copper Water Tube
A 240	Chromium and Chromium Nickel Stainless Steel Plate Sheet and Strip for Fusion Welded Uni fired Pressure Vessels
A 307	Low Carbon Steel Externally and Internally Threaded Standard Fasteners
D 1784	Rigid Poly (Vinyl chloride) Compounds, and Chlorinated Poly (Vinyl Chloride) Compounds
D 2239	Polyethylene (PE) Plastic Pipe (SDR PR)
D 2241	Poly Vinyl Chloride (PVC) Plastic Pipe (SDR PR and Class T)
D 3139	Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals

D. Rule for Safe Drinking Water, Georgia State EPD: Chapter 391-3-5.10

1.03 DESCRIPTION

A. All valves of the same type shall be from a single manufacturer. Parts for valves of the same type and size shall be interchangeable. Spare parts shall be furnished where required in the payment items. Special tools required for repacking or dissembling valves shall be provided.

B. All valves shall open left (counterclockwise).

1.04 SUBMITTALS

A. Six copies of the manufacturer's drawings and catalog cuts of the following items shall be submitted for approval of the Design Engineer:

1. Pipe
2. Fittings
3. Joints and Couplings
4. Hydrants
5. Valves

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials delivered to the site shall be inspected for damage, unloaded, and stored with the minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and rubber gaskets under cover and protect from exposure to direct sunlight. Store materials above ground. Interior of pipe and fittings shall be kept free of dirt and debris.

B. Pipe, fittings, valves, hydrants, and other accessories shall be handled to insure delivery to the point of installation in sound undamaged condition. If coatings or linings of pipe or fittings are damaged, such pipe or fittings shall be removed from the site and new materials furnished. Pipe shall not be dragged. Rubber gaskets that are not installed immediately shall not be left in the sunlight but shall be stored under cover and protected from exposure to direct sunlight.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC)

A. IPS Size PVC Pipe: Class 200 SDR 21 - Polyvinyl chloride water main pipe shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe shall be Class 200, SDR 21. The standard laying length shall be 20 ft. ±1 inch.

B. DIP Size PVC Pipe: AWWA C-900

1. C-900 polyvinyl chloride water main pipe 4" TO 12" shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe larger than 4" to 12" shall meet the requirements of AWWA C900, "Poly Vinyl Chloride (PVC) pressure pipe." All pipe shall be class 200 pipe and shall meet the requirements of DR14. The standard laying length shall be 20 ft. ±1 inch. The FM approved pressure class will be used to determine pressure class.

2. C-905 polyvinyl chloride water main pipe 14" to 30" shall be manufactured from compounds conforming to PVC cell classification of 12454B as defined in ASTM D-1784. The integral bell joint system meets the requirements of ASTM D-3139 and utilizes an elastomeric gasket materials conforming to ASTM F-477. All pipe shall be class 200 pipe and shall meet the requirements of DR18. The standard laying length shall be 20 ft. ±1 inch.

C. When DIP size PVC pipe is used two 2" PVC pipe shall be SDR 21, minimum pressure class of 200psi.

D. Pipe shall have integral bell and spigot joints. Provisions shall be made for contraction and expansion at each joint with an elastomeric ring. Threaded or solvent welded type joints shall not be used. Bell end pipe and couplings with elastomeric gaskets shall meet the requirements of ASTM 3139.

E. All fittings such as tees, ells, etc. using welded joints shall be factory welded and shall meet the same specifications as the welded bell section. Lubricants shall be non-toxic,

shall not promote biological growth. Solvent cemented joints are not allowed for buried pipes.

F. The Contractor shall install a continuous run of 14 gauge copper tracer wire with underground coating above the top of the PVC pipe 12 inches above the pipe but no deeper than 48 inches below finished grade. The tracer wire shall be suitable for detection with metal pipe location equipment.

G. All water pipe shall be blue in color and labeled “water” every three feet as a minimum.

H. Pipe shall carry National Sanitation Foundation (NSF) seal and be factory marked with manufacturer's identification, pipe size, material and pressure rating. Detection tape shall be placed along all PVC water mains.

2.02 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to the requirements of ANSI Standard A21.51 and AWWA C151. All pipe shall class 350. Class designations for the various classes of pipe shall be painted on the outside of each joint of pipe. Weights shall be conspicuously painted in white on each joint of pipe after the bituminous coating has hardened.

B. All joints shall have the same pressure rating as the pipe with which it is used. Joints shall be rubber gasketed push on or mechanical joint. Joints shall meet the requirements of ANSI A21.11 and AWWA C111.

A. Pipes shall be cement lined in accordance with the latest edition of AWWA Standard C104.

2.03 GALVANIZED STEEL PIPE

A. This pipe and fittings shall conform to the requirements of ASTM A120. The pipe shall be "standard weight", unless otherwise specified.

2.04 PLASTIC TUBING

A. Plastic pipe shall conform to all the requirements of the "Specifications for Polyethylene (PE) Plastic Pipe (ADR PR)", as they apply to PE 3306 of ASTM D2239.

B. The hydrostatic design stress shall be 630 psi for water at 23° centigrade (73.4° F) and 500 psi for water at 37.8° C (100° F).

C. The polyethylene extrusion compound from which the pipe is extruded shall meet the requirements of Type III, Grade 3, Class C material as described in "Specification for Polyethylene Molding and Extrusion Materials", ASTM D1248, except that melt index shall be determined under a higher temperature than any of the conditions as listed in Section 6(b) of "Method of Test for Measuring Flow Rates of Thermoplastics by Extrusion Plastometer", ASTM D1238. The test condition shall be the same as for condition J, except that the temperature shall be 310° C (590° F), with a load of 12 5 kilograms. Under these conditions the resin shall extrude at a maximum rate of 0.25 grams per ten (10) minutes. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, capacity, density, and other physical properties.

D. The size, the type of plastic pipe material, dimension ratio, commercial standards with which the pipe complies, the manufacturer's name and the National Sanitation Foundation (NSF) seal of approval, shall be conspicuously marked on the outside of the pipe at intervals of not more than five (5) feet.

2.05 FITTINGS

B. Fittings shall be ductile iron and shall conform to the latest edition of AWWA Standard C110 or C153. The fittings shall be of the lightest class conforming to the pressure rating of the pipelines in which they are installed. In no case shall the fittings be lighter than class 200.

C. Fittings for galvanized steel pipe shall be malleable iron conforming to ANSI B16.3 except the nipples and couplings shall be the same material as the pipe. All fittings shall be hot dip galvanized in accordance with ASTM A120.

D. Pipe having mechanical joints or slip-on joints with rubber gaskets shall be used. Lead-tip gaskets shall not be used.

E. The mechanical joint shall meet the requirements of AWWA C111 and shall have the same pressure rating as the fitting of which it is a part.

F. Fittings shall be cement lined in accordance with the latest edition of AWWA Standard C104.

2.06 HYDRANTS

A. All fire hydrants shall conform to AWWA C502.

B. All fire hydrants shall have a 6" mechanical joint inlet connection and be equipped with a 5 1/4 inch valve, two 2 1/2 inch hose nozzles, and one 4 1/2 inch pumper connection, all with ANSI (National) standard threads. Operating nuts shall be 1 1/2 inch, pentagon type.

C. All fire hydrants shall be equipped with "O" ring-type stem seals.

D. All fire hydrants shall be designed for 150 psi working pressure and 300 psi test pressure.

E. All fire hydrants shall be equipped with a 6" gate valve, complying with other sections of the specifications, installed on the fire hydrant lead between the hydrant and the main.

F. The Contractor shall paint the hydrant with XO 14 Tractor Red (Federal Safety Color) paint.

G. All fire hydrants shall be designed such that clockwise rotation of the stem closes the valve and counterclockwise rotation opens the valve. Hydrant covers shall have the word "Open" and an arrow showing the proper rotation of the operating nut cast in or permanently attached.

H. An independent drain shall be provided, completely draining the hydrant after use. The drain shall be activated to the open position by the closing of the hydrant valve. The drain rod shall be easily cleaned. The drain shall have a protective shield integral with the hydrant base to minimize clogging and prevent undermining.

I. All working parts of the hydrant shall be easily removed for inspection or servicing without digging or the use of hoists or derricks or special tools. The hydrant cover and stand pipe shall be removable without requiring the water to be shut off.

J. Each fire hydrant shall be equipped with a ground line mounted breakaway flange and cast iron safety stem coupling specially designed so that upon sustaining severe impact the hydrant will shear off at the ground line without loss of water in the main.

K. All fire hydrants shall be Mueller standard or equal as approved by the Engineer.

2.07 METERS

A. All meters shall be approved first-line products of recognized manufacturers and shall be compatible with the meter reading system currently being used by the water system owner and operator.

B. Meters, meter materials, and meter test shall conform to applicable AWWA Specifications and shall meet or exceed current AWWA Specifications.

C. Each meter shall have manufacturer's serial number on the lid.

D. All body parts as cases, boxes, and lids shall be of bronze composition.

E. Meters shall be split case, positive displacement type.

F. The register shall read in U.S. Gallons and shall be hermetically sealed and driven by permanent magnets.

2.08 METER BOXES

A. The meter box shall be the approved standard product used by the water system owner and operator.

B. They shall be rectangular and of adequate dimension to accommodate the specified meters.

C. Boxes shall have cast iron or polyethylene covers labeled "WATER METER".

D. Boxes for 5/8" by 3/4" meters shall have inside width not less than 10 inches, inside length not less than 15 inches and overall height not less than 12 inches.

E. Boxes shall be designed and built to withstand traffic loads typical of yard installations.

2.09 VALVES

A. All valves 2" in diameter and smaller shall be constructed of brass or bronze except that the hand wheel which shall be of malleable iron construction with screwed ends. All valves 2 1/2" in diameter and larger shall have flanged ends for interior service and mechanical joints for buried service unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze.

B. Gate Valves:

1. Gate valves smaller than three inches shall meet the requirements of Fed. Spec. WW V 54, Class A, 125 pounds.

2. Gate valves three inches and larger shall have nonrising stems and shall meet the requirements of AWWA Standard C 500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thickness and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 150 psi.

3. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze. The glands shall be bronze or bronze bushed. Gland bolts and nuts shall be bronze.

4. All gate valves shall be of the double disc or wedge type. The wedge or disc shall be totally encapsulated in rubber. The sealing rubber shall be permanently bonded to the wedge or disc to meet ASTM tests for rubber metal bond ASTM D249.

5. Valves to have two inches square operating nut, with the exception that gate valves in altitude valves pits shall have hand wheels.

6. Valves buried in ground or located in vaults or structures shall have suitable extensions for socket operation with top of operating nut located two feet below finished grade maximum.

7. Any valve installed in a vault readily accessible for entry shall be equipped with handle wheels in lieu of operating nuts. No hand wheels are allowed in buried valves.

C. Check Valves:

1. Check valves 2" through 24" shall be iron body, bronze mounted swing check valves meeting the requirements of AWWA Standard C508 76.

2. The check valve shall be metal to metal or composite to metal seat construction with flange ends or screw and coupled ends.

D. Altitude Valves:

1. All altitude valves furnished for use in the systems shall be equipped for showing at all times the position of the valve. Said altitude valves shall be of the size specified on the drawings and suitable for the use intended.

2. The Contractor shall supply the services of a qualified manufacturer's representative to check and calibrate each altitude valve installation for proper working pressure and sequence.

E. Air Release Valves

1. Air release valve shall have all bronze body and bonnet. They shall be the direct acting type.

2. Valves shall be hydrostatically tested to at least 150 psi.

3. The valve shall have stainless steel floats and an internal coating with rust inhibitors.

2.10 BACKFLOW PREVENTERS

A. The backflow preventers used shall be those specifically designed for use in connections when the danger from backflow presents a health hazard.

B. All domestic backflow preventers shall be of the reduced pressure type or double check type as shown on plans. All fire protection system backflow preventers shall be of the double check detector type.

C. Backflow preventers 3/4" to 2" shall be Ames LF 2000 B, LF 4000 B, or equal meeting or exceeding the following specifications:

Mainline Case – Bronze or Copper Alloy
Working Parts Bronze & Stainless Steel
Springs Stainless Steel
Diaphragms Buna N and Mylar
Valve disc Silicone Rubber
Check Valve Enclosure Glass Reinforced Plastic
Maximum Rated Working Pressure 175 psi
Temp. Range 33° 180°F

D. Backflow Preventers 2½" to 10" shall be Ames M200, M400, or LFM300 Lead Free or equal meeting or exceeding the following specifications:

Body 8" 10" Stainless Steel
Body 2½" 6" Stainless Steel
Working Parts Stainless Steel
Springs 2½" 6" Stainless Steel

Springs 8" 10" Stainless Steel
Valve Disc Silicone Rubber
Maximum Rated Working Pressure 175 psi
Temp. Range 33° 140°F

E. Backflow preventers larger than 10" shall be designed for conditions that do present a health hazard. It shall be the reduced pressure type and depending on the application, may require detection of leaks or unauthorized use. Detectors above 10" shall be submitted for approval. The submittal shall include complete shop drawings. The submittal will be reviewed based on the product's ability to meet the needs of the project and the Owner.

PART 3 – EXECUTION

A. All valves shall be carefully mounted in their respective positions free from distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project.

B. Valve box, cover, and the concrete pad shall be installed with each valve as shown in miscellaneous details.

3.01 PIPE INSTALLATION

A. PVC pipe shall be installed in accordance with the Uni Bell Plastic Pipe Association guide for installation of polyvinyl chloride plastic pressure pipe for municipal water main distribution system and the printed recommendations of the manufacturer.

B. Ductile iron pipe shall be installed in accordance with AWWA C600. Concrete pipe shall meet the latest edition of AWWA Standard C300.

C. Pipeline alignment and gradient shall be straight or shall follow true curves as near as practicable. Curvature in pipelines, where required, shall be well within the allowable laying radius, horizontal and vertical.

D. Excavation, cleaning, laying, jointing and backfilling shall follow as closely as is possible so as to progress the work. In no case shall pipe be left in the trench overnight without completing the jointing. The completed pipeline shall not be left exposed in the trench unnecessarily, and the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed. Each day at the close of work, and at all times when laying is not in progress, the exposed end of the pipeline in the trench shall be closed with a head or barrier of wood or metal. If at any time it becomes necessary

to cover the end of any uncompleted pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

E. The Contractor shall keep exposed ends of pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall also, before the system is accepted, thoroughly clean all lines.

F. Thrust Blocks (Reaction Blocking) shall be provided as specified AWWA C600. All exposed pipes, valves, hydrants, etc., shall be securely strapped and all ends and bends braced.

G. Other means of pipe restraining in addition to thrust blocking shall include "mega lug" utilization and all threads bolted through fittings in accordance with AWWA C600. Thrust blocking may not be eliminated with the use of joint restraint.

H. Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water, and pushed into position making sure the gasket is evenly seated in the socket. The gland shall then be properly positioned for compressing the gasket. All bolts and nuts shall be tightened with a torque wrench to a uniform, permanent tightness. Bolts shall be tightened alternately 180 degrees apart. Sockets, spigots, glands and bolts shall be kept clean and wet with soapy water until each joint is completed.

I. All water distribution mains shall have a minimum 36" of cover.

3.02 INSTALLATION OF MAINS

A. Water lines must not be installed in contaminated areas such as sanitary landfill or dump areas.

B. No water main or pipe shall pass through or come into contact with any part of a sewer or sewer manhole.

C. A continuous and uniform bedding shall be provided in the trench for all buried pipe.

D. Backfill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect pipe.

E. Thrust restraint shall be provided at all points where hydraulic thrust may develop. This will include providing reaction blocking, tie rods or joints designed to prevent movement to all bends, tees, valves, plugs, hydrants and other points where thrust may

develop. Additional restraints may be necessary on fusible pipe at the connection to appurtenances or transitions to different pipe materials to prevent separation of joints. The restraint may be provided in the form of an anchor ring encased in concrete or other methods as approved by the Division.

F. Whenever a state route or heavily traveled off-system road or a railroad is crossed, the agency that has jurisdiction over the road or the railroad must be notified, prior to the installation of the mains. At the crossing, a steel casing with sufficient diameter must be jacked and bored to accommodate the carrier pipe. Any free boring at low traffic city streets and county roads must conform to the applicable local and/or state requirements.

G. Installation of water lines and appurtenances along highways, streets and roadways must comply with the applicable regulations of, and permits issued by, the Georgia Department of Transportation, local County and Municipality with reference to construction operations, safety, traffic control, road maintenance and repair.

H. When non-metallic pipe is installed, detection tape shall be installed.

I. Any pipe, pipe fittings, plumbing fittings or fixtures, solder, or flux used in the installation or repair of a public water system must meet the new definition of lead free meaning: (a) not containing more than 0.2 percent lead when used with respect to solder; and (b) not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.

J. If soils are found to be aggressive, the water main shall be protected by encasement in polyethylene, the provision of cathodic protection (in very severe instances), or the use of corrosion resistant water main materials.

K. Stones found in the trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe.

L. All distribution mains shall be provided with sufficient earth and other suitable cover to prevent freezing. This shall be not less than 24 inches measured above the top of pipe.

3.03 FIRE HYDRANT INSTALLATION

A. Fire Hydrants shall meet the current AWWA Standard C502.

B. All fire hydrants shall have 36" minimum pipe cover provided for the branch supply line.

C. Each fire hydrant shall be set on a stable foundation at least 18 inches square and 6 inches thick and shall be blocked against the end of the trench with concrete and anchored.

D. Hydrant drainage shall be provided by installing around the hydrant at least 7 cubic feet of gravel or crushed stone below the top of the hydrant supply pipe.

E. The barrel of the fire hydrant shall be set plumb (perpendicular to the ground) with the lowest discharge outlet at least fifteen (15) inches high but no higher than 24 inches above finished grade. No fire hydrant shall be installed within 10 feet of any private driveway. Hydrants shall be located no closer than 5 feet of a curbing and no further than 12 feet of the curbing.

F. Immediately before installation of a hydrant, the following operations shall be performed:

1. The hydrant shall be thoroughly inspected.

2. The hydrant interior shall be thoroughly cleaned.

3. The hydrant shall be opened and closed to determine that all parts are in proper working order, with valves seating properly and the drain valve operating freely.

3.03 HYDROSTATIC TEST

A. Upon completion of backfilling operations and not less than seven (7) days after the last concrete blocking anchor has been poured, the pipe system shall be subject to hydrostatic test.

B. Pressure and leakage tests shall be performed in accordance with the latest edition of AWWA Standard C600.

a. For PVC: Allowable leakage shall be no greater than as calculated in L=ND (P)1/2/7,400 where L is allowable leakage in gallons/hour, N is the number of joints in the length of pipe tested, D is the nominal diameter of the pipe in inches and P is average test pressure during the leakage test in pounds per square inch (psi-gauge).
b. For DIP: Allowable leakage shall be no greater than as calculated in L=SD (P)1/2/133,200 where L is allowable leakage in gallons/hour, S is the length of pipe tested in feet, D is the nominal diameter of the pipe in inches and P is

average test pressure during the leakage test in pounds per square inch (psi gauge).

C. The system shall be filled with water and all air expelled.

D. The Contractor shall pressurize the system to 1.5 times the working pressure or 150psi, whichever is greater, at the highest point in the system.

E. The test pressure shall be maintained for two hours.

F. If the pressure cannot be maintained, the cause shall be determined, corrected and test repeated until successful.

3.04 LEAKAGE TEST

A. Following the pressure test, the system shall be subject to a leakage test.

B. Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the design working pressure after all air in the pipe line has been expelled and the pipe has been filled with water.

C. Leakage shall not exceed the quantity determined by the formula given below:

L = ND(Square Root of P)/7400

WHERE	L	=	allowable leakage in gallon/hr.
	N	=	number of joints in pipe line
	D	=	nominal diameter of the pipe inches
	P	=	average test pressure during leakage test in psig

D. If leakage exceeds the allowable rate, leaks shall be found and repaired and the test repeated until successful.

3.05 CORROSION CONTROL

A. General:
   a. All treated water shall be evaluated to ensure that water quality parameters and characteristics are optimized to obtain the desired water stability throughout the distribution systems of a water supply.

   b. The primary approaches to internal corrosion control in drinking water systems are to modify the water chemistry to make it less corrosive and to encourage

formation of passivating films on the contacting surface. This is typically accomplished through pH and/or alkalinity adjustment or through the addition of a corrosion inhibitor. Most corrosion control treatment will be beneficial for reducing corrosion of lead, copper, iron, steel and galvanized pipe.

c. Where adjustments to water quality parameters such as chlorine residual, pH, alkalinity or carbonate buffer strength prove insufficient to control corrosion rates, the use of corrosion inhibitors should be considered. Orthophosphate is particularly effective for this purpose in most situations.

d. To control corrosion, certain basic approaches can be utilized:

   i. Using pipe materials and designing the system so it is not corroded by a given water;
   ii. Modifying the water quality so it is not corrosive to the pipe material; and
   iii. Placing a protective barrier or lining between the water and the pipe.

B. Corrosion Control Study:

a. Monitoring/testing equipment shall be provided for determining the effectiveness of stabilization treatment and the chemical residuals at the entry point and in the distribution system, including an acceptable pH probe that utilizes three standards for calibration.

b. A sample site location plan for water quality parameter monitoring. Entry point and distribution system samples shall be collected for water quality data and other system information pertinent to achieving optimum corrosion control. The frequency of sampling and number of sites shall be determined by the Division. The water quality parameters include:

pH	Conductivity
Temperature	Hardness
Alkalinity	Iron
Calcium Manganese	Sulfate Aluminum
Ammonia	Dissolved Oxygen
Total Phosphorus	Natural Organic Matter
Chloride	Total and Free Chlorine Corrosion Control Inhibitors
	Total & Free Chlorine (Orthophosphate, Silica)

c. A summary of all water quality parameter monitoring results. These results should be evaluated considering the location of sample sites within the

distribution system and used as the basis for considering corrosion control treatment options.

d. A desktop evaluation utilizing corrosion control computer modeling or regulatory guidance. The evaluation shall recommend optimal corrosion control treatment and water quality parameter performance requirements for the selected treatment.

e. Identification of possible limitations and secondary impacts for treatment options.

C. Adjustments to water quality

a. pH adjustment by the addition of lime, caustic soda or soda ash in order to stabilize the water with regard to calcium carbonate. Advantages of aeration for iron, H2S or CO2 removal should be balanced against the fact that dissolved oxygen is a corrosive agent.

b. pH/Alkalinity adjustment includes adding a base or similar chemical to the water to increase pH to a level where the practical lead or copper solubility lowers, acids are neutralized, and less soluble metal compounds are formed on the pipes. Treatment shall be designed to operate within the optimum pH range and alkalinity concentration.

i. Caustic Soda- Caustic soda (sodium or potassium hydroxide) will increase the pH with minimal effect on alkalinity and dissolved inorganic carbon (DIC). A stable pH is very difficult to provide when using caustic soda on water having low alkalinity. Caustic soda can cause severe burns and damage the eyes.

ii. Soda Ash- Soda ash (sodium or potassium carbonate) will increase the alkalinity, DIC, and moderately increase the pH. Soda ash is relatively safe to handle compared to caustic soda.

c. Aeration

i. Aeration can increase the pH and reduce excess DIC by removing carbon dioxide. Aeration is most effective when there is an adequate carbon dioxide concentration in the water.
ii. The carbon dioxide content of aggressive water may be reduced by aeration.

3.06 DISINFECTION

A. Water mains and accessories shall be disinfected in accordance with "Rules for Safe Drinking Water" as published by the Georgia Environmental Protection Division.

B. The mains shall be flushed intro the storm drainage system before disinfecting by maintaining a velocity of at least 2.5 feet per second for a period of ten minutes.

C. The continuous feed method may be used for any size main or system where satisfactory quantity and quality water is available. The tablet method shall not be acceptable.

D. Following disinfection of the water system, the system shall be flushed until chlorine concentration is less than 1 milligram per liter. Flushing shall not allow chlorinated water to be discharged into the storm sewer system without first allowing the chlorine in the system to dissipate. The contractor Shall use a Pollard Water LPD-250 or equal equipment along with LPD-Chlor tablets (Sodium Sulfate or Ascorbic Acid) to de-chlorinate the water using 1 tablet per 2000 gallons of water minimum prior to flushing, then after adequate testing, discharge the de-chlorinated water to the storm sewer system or onto the land surface. During the de-chlorination flushing the flow through the LPD 250 will be maintained at between 200 and 1200 GPM. No flows for de-chlorination or flushing will not be allowed outside this flow specification. The contractor may apply to the owner of the sanitary sewer system to obtain permission to discharge the chlorinated water into the sanitary sewer system for a fee. The contractor shall be charged at the going rate per gallon for treating the water discharged to the sanitary sewer system.

E. When new water mains are placed in or returned to service, they shall be disinfected in accordance with the latest addition of AWWA Standard C651.

    a. Before the main is chlorinated, it shall be filled to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet/second is usually maintained in pipe sizes less than 24 inches in diameter. For larger diameter mains, an alternative to flushing, such as broom-sweeping of the main, is acceptable prior to chlorinating the main.

    b. During disinfection of the water mains, an appropriate cross-connection control device, consistent with the degree of hazard, shall be provided for backflow protection of the active distribution system.

    c. The quality of the water used during the disinfection procedures shall meet the required drinking water standards.

d. The chlorine solution used for the "continuous feed" method of disinfection of water mains shall have a free chlorine residual concentration not less than 25 mg/L. This heavily chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine. Re- chlorinate if required results are not obtained on all samples.

e. After the applicable retention period, the heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals, such as Sulfur Dioxide, Sodium Bisulfite, Sodium Sulfite or Sodium Thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted.

f. Flush all lines until residual is equal to existing system. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391- 3-5. The laboratory results must show the absence of coliform organisms in the water. Reflush and re-disinfect the lines, as necessary, until satisfactory bacteriological results are obtained.

F. When cutting into existing mains, for abandonment or reuse, the pipes must be disinfected. a. All water mains that are depressurized and/or wholly or partially dewatered shall be disinfected in accordance with the current AWWA C651 Standards, including swabbing with hypochlorite solution, flushing, and/or slug chlorination as appropriate. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure may require no disinfection.

a. Chlorine required to produce 25 mg/L concentration in 100 feet of pipe by diameter:

Pipe Diameter (inches)	100% Chlorine (lbs.)	(g)	1% Chlorine Solution (gal)	(L)
4	0.013	5.9	0.16	0.6
6	0.030	13.6	0.36	1.4
8	0.054	24.5	0.65	2.5
10	0.085	38.6	1.02	3.9

12	0.120 54.4	1.44 5.4
16	0.217 98.4	2.60 9.8

Note: 1% chlorine solution may be prepared with sodium hypochlorite (contains 5% to 15% available chlorine) or calcium hypochlorite (contains approximately 65% available chlorine by weight). To prepare 1% chlorine solution using calcium hypochlorite, add one (1) pound (454 grams) of calcium hypochlorite in approximately 8 gallons of water.

b. Amounts and types of chemicals advised to be used for neutralizing various residual chlorine concentration in 100,000 gallons of water

Residual Chlorine Concentration	Chemicals							
	Sulfur Dioxide (SO2)		Sodium Bisulfate (NaHSO3)		Sodium Sulfite (Na2SO3)		Sodium Thiosulfate (Na2S2O3.5H2O)	
Mg/L	Lb.	Kg	Lb.	Kg	Lb.	Kg	Lb.	Kg
1	0.8	0.36	1.2	0.54	1.4	0.64	1.2	0.54
2	1.7	0.77	2.5	1.13	2.9	1.32	2.4	1.09
10	8.3	3.76	12.5	5.67	14.6	6.62	12.0	5.44
50	41.7	18.91	62.6	28.39	73.0	33.11	60.0	27.22

G. Surface water crossings, both over and under water, may present special concerns and should be discussed with the Division before the final plans are prepared.

a. At above water crossings, the pipe shall be adequately supported and anchored, protected from vandalism, damage and freezing, and accessible for repairs or replacement. At underwater crossings, a minimum of 3 feet of cover shall be provided over the pipe.

b. The installation of ductile iron pipe with restrained push-on joints and encased in concrete, may be considered with the prior approval of the Division. Otherwise, when crossing water courses which are greater than 15 feet in width, only pipes of special construction, having flexible, watertight joints shall be installed.

c. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; valves shall be easily accessible and not subject to flooding. Sampling taps shall be installed at each end of the crossing, and permanent taps shall be made for testing and determining leaks.

H. There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water and other contaminating materials may be discharged or drawn into the system.

   a. The approval of the Division shall be obtained for interconnections between potable water supplies.

   b. Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply

I. Water services and plumbing should conform to relevant local and/or state plumbing codes, or to the Standard Plumbing Code, as applicable within the jurisdiction in which the system is located. The product that is used for the service line must be listed as being certified for conformance with the NSF Standard 61.

   a. All new and existing services connected to community and non-transient noncommunity water systems shall be individually metered.

   b. Individual booster pump(s) shall not be allowed for any individual residential service from the public water supply mains. Where permitted for other types of services, booster pumps shall be designed in accordance with AWWA standards.

J. Water loading stations present special problems since the fill line may be used for filling both potable water vessels and other tanks or contaminated vessels. To prevent contamination of both the public supply and potable water vessels being filled, the following principles shall be met in the design of water loading stations:

   a. there shall be no backflow to the public water supply;

   b. the piping arrangement shall prevent contaminant being transferred from a hauling vessel to others subsequently using the station; and

   c. hoses shall not be contaminated by contact with the ground.

A. Bacteriologic Tests:

   1. Bacteriological testing shall be performed after the repairs are complete. However, depending upon the circumstances, the water main may be returned to service prior to completion of testing to minimize the time the customers are out of service.

2. Tests shall be performed to detect the presence of coliform organisms on samples taken from the end farthest from the point at which chlorine was introduced into the system and at 1000 ft. intervals.

3. The bacteriological sample shall meet the requirements established by EPD for suitable disinfection for human consumption.

4. If unsatisfactory samples are produced, disinfection shall be repeated until samples are satisfactory.

END OF SECTION

SECTION 02611
BASE AND PAVING

PART 1 – GENERAL

1.01 APPLICABLE STANDARDS

A. When used in this section, the term "Standard Specifications" shall mean the DEPARTMENT OF TRANSPORTATION, STATE OF GEORGIA STANDARD SPECIFICATIONS – CONSTRUCTION OF TRANSPORTATION SYSTEMS 2013 or later edition.

B. American Society for Testing and Materials (ASTM):

D 698 Test for, Moisture Density Relations for soils
D 1557 Test for, Moisture Density Relations for soils

PART 2 – PRODUCTS

2.01 MATERIALS

A. Base: The base shall conform to Section 310, Graded Aggregate Construction, of the Standard Specifications.

B. Prime: The prime coat shall be RC 70 and shall conform with Section 412, Bituminous Prime, of the Standard Specifications.

C. Tack Coat: The tack coat shall be RC 70 and shall conform with Section 413, Bituminous Tack Coat of the Standard Specifications.

D. Intermediate Course (Binder): The intermediate course shall be Superpave 12.5 mm or 19 mm Asphaltic Concrete and shall conform with Section 402, Hot Mix Asphaltic Concrete Construction of the Standard Specifications.

E. Crack Relief Interlayer: The crack relief interlayer shall be OGI Asphaltic Concrete and shall conform with Section 415, Asphaltic Concrete Open Graded Crack Relief Interlayer of the GDOT Standard Specifications and Special Provisions.

F. Surface Course Asphalt Plant Mix: The surface course shall be either Superpave 9.5 mm or 12.5 mm Asphaltic Concrete and shall conform with Section 402, Hot Mix Asphaltic Concrete Construction, of the Standard Specifications.

G. Paint: Paint for pavement marking shall be in conformance with MUTCD publication and shall conform with Section 870, Paint, of the Standard Specifications.

H. Concrete Curb and Gutter: Shall conform to Section 441 Concrete Curb, Gutter, Combination Curb and Gutter, Header, and Median of the Standard Specification.

PART 3 – EXECUTION

3.01 COMPACTION

A. Sub-grade: The upper 24 inches of sub-grade soils in all cut areas and all fill areas that are to receive new pavements shall be scarified and re-compacted until a density equivalent to 95% standard Proctor maximum dry density in accordance with ASTM D698 has been obtained.

B. Base: All base shall have minimum compaction of 100% of the maximum density obtained by the test procedure present in ASTM D1557, Method D (Modified Proctor). The maximum permissible lift thickness shall be 6 inches (compacted). The contractor shall be required to perform all work necessary to meet the minimum compaction requirements.

C. Moisture Content: Compaction shall be performed only when the moisture content of the soil is within 4% of the optimum moisture content at the time of compaction as determined by ASTM D698. Soils are to be dried prior to compaction by discing and aeration. An Independent Testing Laboratory shall determine if soils are within the optimum moisture content. The contractor shall be required to perform all work necessary to meet the minimum compaction requirements.

3.02 CONSTRUCTION

A. Preparation of Sub-grade: Prior to placing of base and pavements, the construction of all utility lines (water, sewer, power, gas, etc.) which are to be placed under the pavements shall have been completed.

B. Base: The base course shall be constructed in accordance with Section 310 of the Georgia Department of Transportation Standard Specifications to the compacted thickness specified.

C. Prime: The prime coat shall be applied at a rate of 0.25 gallons per square yard and in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications.

D. Tack Coat: The tack coat shall be applied at a rate of 0.10 gallons per square yard and in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications.

E. Crack Relief Interlayer: The crack relief interlayer shall be constructed in accordance with GDOT Section 415 of the Georgia Department of Transportation Standard Specifications and Special Provisions.

F. Intermediate and Surface Course Asphalt Plant Mix: The intermediate and surface courses shall be constructed in accordance with Section 402 of the Georgia Department of Transportation Standard Specifications to the thickness indicated. All thicknesses are compacted.

G. Painting Stripe: Pavement striping is required and shall be in accordance with Georgia Department of Transportation MUTCD publication.

H. Existing pavement which has pavement markings damaged by this construction shall be repainted.

I. Concrete Curb and Gutter: Shall be constructed in accordance with Section 441 of the Georgia Department of Transportation Standard Specification.

3.03 TESTING

A. Compaction testing shall be performed by an approved testing laboratory. Sub-grade and base compaction testing shall be performed at a spacing not to exceed 500' staggered for the entire length of the street. On streets shorter than 1,000' the testing spacing shall reduce to 300' and in no case will be less than three tests per street, equally spaced. The Design Engineer and Construction Inspector shall be provided copies of the test information prior to placement of base material or final pavement.

B. Prior to the installation of any base material a test roll must be performed along the entire roadway length, both sides of the road. The test roll shall be performed utilizing an 18 C.Y. tandem axle dump truck loaded with at least 12 C.Y. of soil or gravel. The same test roll will be required on the base material prior to beginning pavement installation. The Design Engineer and Construction Inspector shall be present during the test roll.

C. Prior to beginning the installation of any asphalt pavement, the base material shall be tested to determine thickness and graded cross section of the base material. The contractor shall provide labor and equipment to auger through the base material to

check to insure the thickness specified in the plans and specifications has been achieved. In addition, the cross slope of the base and the depth below the gutter face shall be checked, utilizing a string line, to insure proper crown and asphalt depth at the edge has been achieved with the base grading. If the depth of base material is insufficient the base present will be removed, the subgrade lowered and adequate base material will be replaced to achieve the required thickness. If the cross slope or edge depth is determined to be less than the specified thickness, the area will be rejected until the area is re-graded to the slope and the thickness specified on the approved plan.

D. The Owner at his option may check the thickness of the asphalt pavement and base material after the installation is complete. If the Owner finds the materials to be less than specified the contractor/developer shall take necessary measures to meet the requirements of the approved plans and specifications.

E. Prior to any striping being performed, the contractor shall prepare a striping plan for approval by the Construction Inspector.

3.04 EXISTING PAVEMENT RESTORATION

A. Pavement damaged due to construction shall be patched or replaced in accordance Section 400 of the Georgia Department of Transportation Standards and Specifications.

B. Pavement damaged by new utility trenches shall be restored in accordance with the pavement removal and replacement details. Any pavement removed must be disposed of by the contractor at a permitted site.

C. Existing inlets, manholes, or valve boxes shall be adjusted by the Contractor to the new grade lines and elevations. All adjustments to structures in areas proposed for pavement shall be accomplished prior to construction of the surface course.

D. Adjustment to grade of existing frames shall include raising or lowering the upper portion of the structure, including any necessary sleeve extensions, adjustable manhole rings, gaskets, mortar, masonry or other approved material, to bring the frame to the required grade.

3.05 STRIPING OF PAVEMENT MARKINGS

A. Striping shall consist of furnishing and applying traffic markings with paint or thermoplastic in accordance with the contract drawings and specifications, and the requirements of the current Federal and State "Manual On Uniform Traffic Control Devices."

B. Thermoplastic Plastic Stripe shall consist of solid or broken (skip) lines, words and/or symbols of the type, color and the location shown on the plans. It is the intent of these specifications that short lines which are defined to be crosswalks, stop bars, arrow symbols and crosshatching shall be extruded. All other lines, unless otherwise specified, shall be sprayed.

C. Cleaning: All pavement areas to be striped shall be thoroughly cleaned. Cleaning may be accomplished by the use of hand brooms, rotary brooms, air blasts, scrapers or other approved methods which leave the paving surface thoroughly clean and undamaged. Particular care shall be taken to remove all vegetation and road film from the area to be striped.

D. Warranty: The Contractor shall transfer to the Governing Authority the warranty on Thermoplastic materials issued by the Manufacturer.

END OF SECTION

SECTION 02650
SANITARY SEWERS

PART 1 – GENERAL

1.01 APPLICABLE STANDARDS

A. American National Standards Institute (ANSI):

A21.4	Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water
A21.6	Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
A21.11	Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
A21.51	Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids

B. American Society of Testing and Materials (ASTM):

A48	Gray Iron Castings
C12	Installing Vitrified Clay Sewer Pipe
C425	Compression Joints for Vitrified Clay Bell and Spigot Pipe
C478	Precast Reinforced Concrete Manhole Sections
C594	Compression Couplings for Vitrified Clay Plain End Pipe
C700	Extra Strength and Standard Strength Clay and Perforated Clay Pipe
D1784	Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds
D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR PR and Class T)
D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
D2774	Underground Installation of Thermo plastic Pressure Piping
D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3139	Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
D3212	Sewer Pipe Joints using Elastomeric Seals

C. American Water Works Association (AWWA):

C 600	Installation of Cast Iron Mains

1.02 SUBMITTALS

A. Materials used in the sanitary sewer system shall be submitted for approval to the Design Engineer. The Design Engineer shall review the drawings, provide a list of materials and certify compliance to the Owner.

B. Six copies of shop drawings or manufacturer's standard drawings or catalog cuts shall be submitted for the following:

1. Precast concrete manholes
2. Manholes and Frames
3. Gaskets One of each type
4. Pipe One of each type
5. Valves One of each type

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for handling and storage of all materials and damaged materials shall not be used in the work. Materials delivered to the site shall be promptly inspected for damage upon arrival. Damaged or defective materials to be immediately removed from the site.

B. All materials to be stored at least 12 inches above grade. Inside of pipes and fittings shall be kept free of dirt and debris. Rubber gaskets and plastic pipe not used immediately shall be protected from direct sunlight. Manhole units shall be handled with care to avoid chippage or breakage.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Polyvinyl chloride pipe and fittings for gravity sewers shall be SDR 35 for less than 12’ bury and SDR – 26 for 12’ bury and over, meeting ASTM D3034 for type PSM Polyvinyl Chloride (PVC) sewer pipe. The joints shall be Push On "O" ring gasket type with integral bell and spigot meeting ASTM 3212. Threaded or solvent welded type joints shall not be used.

B. Polyvinyl chloride pressure pipe shall meet one of the following specifications:

1. IPS Size PVC Pipe: Class 200 SDR 21 - Polyvinyl chloride water main pipe shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC

compound conforming to ASTM D1784. All pipe shall be Class 200, SDR 21. The standard laying length shall be 20 ft. ±1 inch.

2. DIP Size PVC Pipe: AWWA C-900-07

a. C-900 polyvinyl chloride water main pipe 4" TO 12" shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe larger than 4" to 12" shall meet the requirements of AWWA C900, "Poly Vinyl Chloride (PVC) pressure pipe." All pipe shall be class 200 pipe and shall meet the requirements of DR14. The standard laying length shall be 20 ft. ±1 inch. The FM approved pressure class will be used to determine pressure class.

b. C-905 polyvinyl chloride water main pipe 14" to 30" shall be manufactured from compounds conforming to PVC cell classification of 12454B as defined in ASTM D-1784. The integral bell joint system meets the requirements of ASTM D-3139 and utilizes an elastomeric seal conforming to ASTM F-477. All pipe shall be class 200 pipe and shall meet the requirements of DR18. The standard laying length shall be 20 ft. ±1 inch.

c. When DIP size PVC pipe is used two 2" PVC pipe shall be SDR 21, 200 PSI pressure class, iron pipe

C. Marking: Pipe shall be clearly marked with:

1. Manufacturer's Identification
2. Nominal Pipe Size
3. Material, Type and Grade
4. SDR or Pressure Rating
5. All gravity sewer pipe shall be green. Force main pipe shall be white or brown.
6. All pipe regardless of color shall be clearly marked "SEWAGE FORCE MAIN" or "GRAVITY SEWER" as appropriate, marked every three feet.

2.02 DUCTILE IRON PIPE AND FITTING

A. Type: Coated Ductile

B. Joints:

1. Push on type in accordance with ANSI A21.11.

2. Mechanical joint in accordance with ANSI A21.11 and fittings may be in accordance with A21.53..

C. Ductile iron pipe shall conform to ANSI A21.51.

D. Pipe shall have a Protecto 401 lining or equal. The lining should have a high resistance to fatty oils, detergents and sewage generated hydrogen sulfide.

E. Pipe shall be coated outside with one mil. thick bituminous coating conforming to ANSI A21.4 and AWWA C110, C115OR C151.

2.03 REINFORCED CONCRETE PIPE AND MANHOLES (WET WELLS OR VALVE PITS)

A. Precast concrete sections to be manufactured in accordance with provisions of ASTM C478. As a minimum, the interior of all sections shall be coated with two coats of bituminous coating. The first coat shall be spray applied and the second coat should be roller applied. In addition, in extremely corrosive environments, to include force main receiving manholes, wetwells, and the first two manhole from the force main connection shall be lined with sealed HDPE sheet liner. The HDPE liner shall have a watertight seal at all joints and penetrations. The liner shall be Agru Sure Grip Liner or equivalent.

B. Precast concrete riser sections to be 48 inches in diameter with minimum wall thickness of 4 inches.

C. Precast concrete base units to have minimum wall thickness of 5 inches.

D. Jointing material shall be rubber gasket type conforming to ASTM C443 or vulcanized butyl rubber base flexible joint sealer in rope form conforming to Federal Specification SS S 00210, Kent Seal No. 2 or approved equal. The inside and outside of the joint shall be finished with mortar. Mortar shall be one part Port-land cement and two parts sand.

E. Manhole base sections shall provide for a flexible watertight union between pipe and manhole base. Manhole sleeves shall be of high quality synthetic rubber with tensile strength of 1,500 psi, resistant to raw sewage, ozone, acids, and weathering, flexible at temperatures below 0°F and resistant to heat as high as 250°F. A substantial, serrated flange of the sleeve material shall be integrally cast into the wall of the manhole base forming a tight waterseal. The sleeve shall protrude through the wall of the base. A watertight union shall be secured with the end of the pipe with stainless steel strap

clamps. Manhole sleeves shall be Interpace Corp. Lock Joint Manhole Sleeves or approved equal.

F. Pick up holes shall not penetrate the interior walls or the riser.

2.04 MANHOLE FRAMES AND COVERS

A. Frames and covers to have machined bearing surfaces.

B. Covers to have checkered top design and marked "Sanitary Sewer" and include the name of the utility owner.

C. Combined weight of frame and cover shall be approximately 450 pounds.

D. Frame shall have a depth of approximately 9 inches and an access opening of not less than 20 inches.

E. Covers shall have two pick holes located at edges.

F. Materials shall conform to ASTM A48 for Class 30 gray iron castings.

2.05 MANHOLE STEPS

A. Manhole steps shall be constructed of a number 3 reinforcing bar encapsulated in polypropylene plastic with a non skid tread.

B. Finished dimensions of the steps shall be identical to that of malleable iron manhole steps.

C. Steps to have a minimum tread width of 12 inches.

2.06 NUTS AND BOLTS

A. Stainless Steel Flanged: Square head MB/SF, hexagon nuts; ASTM 307B; ANSI B18.2, zinc plated.

2.07 GASKETS

A. Flanged pipe gaskets shall conform to requirements of ASA A21.10 and shall be suitable for the indicated services.

2.08 VALVES

A. All valves two inches in diameter and smaller shall be constructed of brass or bronze except the hand wheel, which shall be of malleable iron construction. Valves two inches in diameter and smaller shall have screwed ends unless approved otherwise. All valves 2½ inches in diameter and larger shall have flanged ends unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze at the contractors option and expense.

B. The contractor shall prepare and submit for approval complete detailed drawings of all valves in accordance with the requirements of the appropriate section of these specifications. All valves of the same type shall be from a single manufacturer. Parts of valves of the same type and size shall be interchangeable. Spare parts shall be furnished as specified under the proposal items. Special tools required for repacking or disassembling valves shall be provided.

C. All valves shall be carefully mounted in their respective positions free from all distortion and strain. All valves shall be properly packed and left in satis¬factory operating condition at the completion of the project. All valves shall open left.

D. Gate Valves

1. Gate valves should not be used in raw sewage applications. Gate valves should only be used where primary and partial secondary treatment has already occurred.

2. Unless otherwise specified or directed, gate valves three inches and larger shall have non rising stems and shall meet the requirements of AWWA Standard C 500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thicknesses and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 125 psi.

3. Unless otherwise specified or directed, gate valves smaller than three inches shall meet the requirements of Federal Specification WW V 54, Class A, 125 pounds.

4. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze as specified or required. The glands shall be bronze or bronze bushed. Gland bolts and nuts shall be bronze.

5. All gate valves 2½ inches in diameter and larger shall be of the double disk type. All gate valves two inches in diameter and smaller may be of the double disk or the solid wedge type.

E. Plug Valves

1. All plug valves shall be the two way type.

2. Nonlubricated, eccentric with resilient faced plugs.

3. Port area of 4 to 20 inch valves shall be at least 70 percent of full pipe area.

4. Valves to be designed for 125 psi working pressure.

5. Bodies to be semisteel with raised seats.

6. Seats to have either a welded in overlay of approxi¬mately 90 percent pure nickel on surfaces contacting the plug face or shall be bronze conforming to ASTM B 62 and attached to the body by stainless steel set screws.

7. Upper and lower plug stem bushings to be stainless steel and shall be permanently lubricated.

8. Exposed nuts, bolts and washers to be zinc plated.

9. Flanges to be faced and drilled to ASA 125 pound standard.

F. Check Valves

1. Type: Ball Check

a. Static head must exceed 10 feet to use ball check valves.
b. No ball check valve will be mounted vertically to compensate for low static head.
c. Ball check ends must be flanged.
d. The body shall be cast iron, ASTM A159 72, Class 35.
e. The ball shall be hollow steel with vulcanized nitrile rubber covering.
f. Pressure rating shall be 150 psi.
g. Valve to be Flygt HDL or equal.

2. Lever Actuate Spring Check Valve

   a. Where static head is less than 10 feet lever action swing check valves shall be used.
   b. Lever action swing checks may be spring and lever type or weight on lever type as approved by the design engineer and the Owner.
   c. Valves shall be installed in the horizontal position.
   d. The valve body, disc, cover and lever shall be cast iron, ASTM A159 72, Class 35.
   e. The disc arm shall be cast steel
   f. The seat ring shall be bronze or stainless steel.
   g. All studs, bolts or nuts shall be commercial grade steel.
   h. The gate shall be rubber faced.
   i. The hinge shaft shall be stainless steel.
   j. The chamber shall be bronze.
   k. The valve shall be Clow F5340 (outside spring and lever) or Clow F5345 (outside weight and lever) or an approved equal.

G. Automatic Sewage Air Release Valve

1. The automatic sewage air release valve shall be designed to allow entrapped air to escape from the sewage force main line. After the air escapes out of the air release valve, the valve shall shut off until more air accumulates in it and the opening cycle will repeat automatically.

2. The sewage release valve must have a compound internal linkage of precision molded delfin or stainless steel. All other internals must be stainless steel to positively prevent galvanic action. The float rod shall be 20" long to provide an air gap between the linkage and waste level inside the valve to retard the waste solids from clogging the linkage. The stainless steel float must withstand a minimum 1000 psi pressure. Each valve shall be complete with hose and blow off valves to permit back flush¬ing without dismantling valve.

Body and cover cast iron	ASTM A48 Class 30
Internal Delfin linkage	ASTMD2133 (or Stainless Steel)
Stainless Float	ASTM A240
Buna N	ASTM SB800

3. Typical installation will utilize standard body valve. Valve height 28" with back flushing attachments 33 1/2". If depth of trench is not deep enough, furnish short valve. Valve height 17 1/2" with back flushing attachments 23 1/2".

4. Automatic sewage air release valve to be as manufactured by Crispin, Val matic, or APCO equal to APCO Series 400 with accessories.

2.09 ACCESSORIES, PLUG, AND GATE VALVES

A. Valves to have two inch square operating nut unless otherwise indicated.

B. Valves buried in ground or located in vaults or structures to have suitable extensions for socket operation with top of operating nut located two feet below finished grades maximum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Plastic piping installation shall be in accordance with ASTM D2321 Recommended Practice for non pressure pipe and ASTM D2774 Recommended Practice for pressure pipe.

B. Ductile iron pressure piping shall be installed in accordance with AWWA Standard C600.

C. Material selection for piping material shall be as indicated. If piping materials are not indicated the Contractor has the option of selecting materials in accordance with this section.

D. Service sewer lines shall be constructed of same material as the mains.

E. Sewer lines shall not be laid closer than 10 feet horizontally to a water main. Pressure sewer lines shall pass beneath water lines, with the top of the sewer being at least 18 inches below the bottom of the water line. Where sanitary sewer lines pass beneath water lines, no joints in the sewer line shall be closer than 10 feet, horizontal the water line. When the vertical or horizontal separation cannot be accomplished, then concrete encasement shall extend a minimum of 10 feet on both sides of crossing.

F. Pipe laying to proceed up grade with pipe bells or groove on the upper end. Pipe to be laid with joints close and even, butting all around. Sagging joints will not be tolerated.

G. Pipe shall be straight and of uniform grade between manholes, laid to line and grade.

H. All sewer shall be designed and constructed to give velocities of not less than 2.0 FPS. Since the Owner has adopted a low flow plumbing device ordinance, the following slopes will be used.

Minimum Slope in Feet

Sewer Size	Per 100 Feet
8"	0.44
10"	0.30
12"	0.24
15"	0.15
18"	0.12
21"	0.10
24"	0.08
30"	0.058
36"	0.046

I. An allowable deviation from the design grades will be allowed up to 5% of the grade shown on the plan. If the grade is steeper than allowed 5% deviation the engineer must verify that the project was installed to all minimum requirements and determine the impact of the additional grade. If the grade is flatter than the 5% deviation, then it exceeds the allowable tolerance and the installation of that line is not acceptable and must be replaced. All sewer mains installed will be field checked for grades during preparation of "Record drawings".

J. Bell holes shall be dug so the pipe barrel will carry the load of the pipe. Pipe shall be bedded in undisturbed earth or, where rock occurs, on a thoroughly compacted layer of #57 stone or sand fill of a minimum thickness of 6 inches under the barrel or bell of the pipe.

K. Where sewers or force mains are to be connected to existing manholes or other structures, and where no stub or opening has been provided for the connection, the Contractor shall make an opening of minimum diameter through the side wall of the structure utilizing a professional coring machine and installing a boot for inserting the sewer pipe. The boot and stainless steel strap shall be sized and installed to create a water tight seal.

L. Lateral connection made to the sewer prior to back filling shall be laid on a slope not exceeding 2 feet vertical to 1 foot horizontal, and not less than 1/8 inch per foot, so that the lateral shall have a solid bearing on undisturbed earth as stipulated for pipe sewers. The lateral shall make such a horizontal angle with the sewer line that a proper connection with the wye or tee branch or slant is obtained without trimming the pipe and with no danger of jointing material being forced into the sewer. All laterals shall be closed by means of suitable stoppers or end caps.

M. Wye or tee branches shall be field located for service to all subdivided lots or inhabitable structures unless otherwise directed by the Architect/Engineer. Wye branches shall be installed so that the lower lip of the branch is not more than 2 inches below the outside top of the pipe. Tees shall be installed with the branch 45° to vertical. After installation, wye or tee branches shall not be covered with backfill until determination and record has been made of the locations of each with reference to the nearest manhole downstream and the direction in which the wye faces.

N. All laterals shall be properly marked on ground surface at the point where laterals terminate with treated timber markers. Timber markers shall consist of a 2 inch by 4 inch timber extending from the end of the lateral vertically to within 2 inches of the ground surface. All such markers shall be securely anchored and maintained in a proper vertical position until backfilling has been completed. The top end of such markers shall be marked or left exposed until an "as built" survey has been made.

O. The top rim of manhole frames and covers shall be set to conform to grades and transverse slopes. Generally along outfall lines, the manhole frames and covers shall extend approximately 6 inches above finished grade or to a designated elevation for flood protection. Generally where lines are located along streets, the manhole frames and covers shall be set flush with the surface.

P. The Contractor shall install a continuous run of plasticized metallic tape above the top of the sewer main at 12 inches to 18 inches below finished grade. Tape shall be suitable for detection with metal pipe location equipment labeled "sewer buried below," and brightly colored to contrast with the soil.

Q. A 14 gauge copper tracer wire with underground coating shall be installed along the route of pressure sewers. The wire shall be located 12 inches above the pipe but no deeper than 48 inches.

R. All PVC pressure pipe shall have a minimum of 36" cover. Areas where the cover is not maintained may require the use of extra strength (D.I.) pipe as directed by the engineer.

S. All sewer mains will be installed at a constant grade and line as shown on the plans. If after video inspection “sags” are found in the line, then the depth of the sag will be determined by the utility owner. If the sag is determined to be deeper than the following chart then the line will be removed and replaced to meet the minimum requirements of these specifications.

Pipe Size	Max. Sag Depth
8”	0.50”
10”	0.50”
12”	0.75”
15”	0.75”
18”	0.75”

3.02 PRESSURE TESTS

A. FORCE MAINS: The Contractor shall test by hydrostatic pressure to 150 pounds per square inch. Each section tested shall be slowly filled with water, care being taken to expel all air from the pipes. The required pressure shall be applied for not less than two hours. No pipe installation will be accepted until the leakage during the pressure test is less than the number of gallons listed below for each 1000 feet of pipe.

6" - 1.5 gallons	12" - 2.75 gallons
8" - 1.75 gallons	14" - 3.00 gallons
10" - 2.75 gallons	16" - 3.5 gallons

B. GRAVITY MAINS: On All sewer mains less than 8’ deep, the Contractor shall pressure test the gravity mains with air. Each section including manholes shall be pressurized to 3.5 psi. The allowable pressure drop of 0.5 psi on any portion of the system shall not be less than the times shown on the following chart.

PIPE SIZE	MINIMUM TIME
4"	3 MIN.
6"	4 MIN.
8"	6 MIN.
10"	7 MIN.
12"	8 MIN.

If the main will not maintain the specified pressure, the Contractor will isolate the weak joint and repair. The test will be repeated until successful. The service lines must be installed at least to the back of the curb prior to testing. These pressure drops represent a maximum infiltration/exfiltration rate of 25 gallons per inch of pipe diameter per mile per 24 hour period.

3.03 ALLOWABLE INFILTRATION/EXFILTRATION

A. If any visible flow is observed in the pipe during installation or final inspection a weir test will be conducted.

B. The leakage inward or outward (infiltration or exfiltration) of the entire system including the sewer mains, service sewers, manholes and wet wells shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system.

C. The weir shall be installed in each manhole. The manhole will then be filled with water to a depth of 3' from the top of the pipe, which should be at the bottom of the weir. The water level will stand for one (1) hour to stabilize then filled (if necessary) to the initial level. During the next hour the water level will be observed and the amount flowing through the weir or the amount of water required to maintain the level will be measured. This measured amount should not exceed the allowable.

3.04 INSPECTION

A. Upon complete installation of the gravity sewer, the Contractor must enter a waiting period of not less than 10 days prior to inspection. In order to initiate the waiting period, the Contractor must notify the Design Engineer and the Owner's inspector in writing of the status of the sewer.

B. After completion of the waiting period all sewer mains must pass a 5% deflection mandrel pulled by hand. If a 5% deflection mandrel will not pass through any section, that section will be replaced or rerounded at the expense of the Contractor. Mandrel to be supplied by the Owner's inspector or by the Contractor, if requested by the Owner.

C. Once the mandrel and physical inspection is complete the contractor will schedule a time when the owner may internally inspect the sewer main utilizing a sewer camera and generating a video inspection of the system. If any defects are found in the system as a result of the internal inspection, then that section of the sewer main and any mains feeding into that system will not be accepted.

D. No sewer main will be accepted if there is any evidence of sagging or bowing in the line which will adversely affect the performance of the pipe. Nor will any sewer mains be accepted if they are laid on a grade substantially less that specified on the Construction Plans. No line will be accepted if laid on less grade than the minimum stated in this specification.

E. All manholes will be inspected for general appearance, cracks, leaks, proper installation of frame and cover, steps and inverts. Any manholes, which do not conform to the specifications, will not be accepted until the deficiency is corrected by the Contractor.

F. All 4" sewer services will be tested for continuity and minimum bends by passing a standard tennis ball. Each sewer service shall be temporarily capped during construction. During the inspection, a tennis ball will be dropped down the open end of

the sewer service. If the ball does not appear in the lower manhole the contractor will excavate the service, correct the blockage and repeat the test until successful.

G. All manhole and wetwell liner systems shall be tested using the “Spark Test” to locate incomplete welds or penetrations in the liner not adequately sealed for gas containment.

3.05 CLEANING

A. Contractor to clean the completed system of any debris or obstructions prior to Final Inspection.

END OF SECTION

SECTION 02821
GRASSING

PART 1 – GENERAL

1.01 APPLICABLE STANDARDS

A. Conform to Section 700 and other applicable articles of the "Standard Specifications Construction of Transportation Systems", of the Department of Transportation, State of Georgia, dated April 18, 2013. Omit all references to measurement and payment.

1.02 SOIL SAMPLES

A. The Contractor shall take soil samples from several areas of the site to be grassed and have them analyzed by the Georgia Extension Service. The results of the analysis shall determine the best fertilizer mixture to use on the site.

PART 2 – MATERIALS

2.01 FERTILIZER

A. Commercial Fertilizer: Fertilizer for lawns shall be a complete fertilizer, the nitrogen content of which shall be derived from either organic or inorganic sources and meeting the following minimum requirements of plant food by weight, unless the soil analysis and report indicates a need for a different fertilizer mixture in which case the recommended mixture shall be furnished and applied. All State and Federal laws relative to fertilizer must be complied with.

10% Nitrogen 12% Phosphoric Acid 12% Potash

B. Ground Limestone: Lime shall be ground dolomitic limestone containing not less than 85% of total carbonates and shall be ground to such fineness that 50% will pass through a 20 mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately on the basis of quantities passing the 100 mesh sieve.

C. Sodium Nitrate shall be a commercial product in dry powder form and shall be delivered in the original, unopened containers each bearing the manufacturer's guaranteed statement of analysis. It shall contain not less than 16% Nitrogen.

2.02 LAWN MATERIALS

A. Kentucky 31 Fescue (Fescue elatior: var. arundinacea): Seed shall be 98% minimum purity and 85% germination.

B. Bermuda Grass (Cyanodon Dactylon): Seed shall be 98% minimum purity and 85% germination.

PART 3 – EXECUTION

3.01 PREPARATION

A. Prepare the seed bed by thoroughly cultivating, discing and hand raking as necessary to produce a smooth even grade free from hollows or other inequalities. Before any seeding is attempted the soil must be in a well pulverized, smooth, friable condition of uniformly fine texture.

3.02 FERTILIZING AND LIMING

A. Approximately two (2) days prior to the start of seeding operations, apply ground limestone at the rate of 20 pounds per 1000 sq. ft. of lawn area. Either in conjunction with the above operation or immediately afterwards apply the specified Commercial Fertilizer over all lawn areas at the rate of 30 pounds per 1000 sq. ft. of lawn area. Work limestone into the top 6 inches of ground and the fertilizer into the top 2 inches of ground.

B. When the grass has started to cover well (approximately 4 weeks after sowing seed) apply 1 1/2 pounds of Ammonium Nitrate to all lawn areas and immediately water using a fine spray. At the end of the maintenance period and prior to the final inspection apply 10 pounds of the specified Commercial Fertilizer per 1000 sq. ft. of lawn area and immediately water.

3.03 SEEDING

A. Before any seeding is attempted the soil must be in a well pulverized, smooth, friable condition of uniformly fine texture. Lawn areas shall be seeded evenly with a mechanical spreader at the rate of 2 lbs. of seed per 1000 sq. ft., 50% in one direction and the remainder sown at right angles to first sowing. The seeded areas shall be lightly raked, rolled with a suitable weight roller and watered with a fine spray.

B. Fescue planting season shall be as approved by Engineer.
C. Bermuda Grass seeding shall be planted only between May 1 to September 1.

D. When grassing is required between curbs and sidewalks, behind sidewalks in areas adjacent to private property, the Engineer may change the type of seeding to that required to match any type of grass which may be planted and growing on the adjacent lawn. No increase in the Contract Sum will be made for this substitution.

3.04 WATERING

A. Soak soil to a minimum depth of 6 inches immediately after seeding. Do not wash away soil or seed. Keep all surfaces continuously moist thereafter until 30 days after the lawn has been seeded. Use fine spray nozzles only.

3.05 RESPONSIBILITY

A. Maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding or resodding as necessary to establish a uniform stand of the specified grasses, and shall continue until final acceptance.

B. All grassed areas that do not show satisfactory growth within 15 days after sowing shall be re sown and re-fertilized as directed until a satisfactory blanket is established. Approximately 3 weeks after sowing the last seed, but not before the seed has taken hold and the grass is growing well, apply sulfate of ammonia or sodium nitrate at the rate of 300 pounds to the acre and water immediately. The lawns shall be considered established when they are reasonably free from weed, green in appearance and the specified grass is vigorous and growing well on each square foot of lawn area. Full coverage is required in 60 days.

C. All grassed areas shall be protected until accepted. All eroded and damaged areas, regardless of cause, shall be immediately repaired and reseeded. Protect lawn areas against traffic.

D. Grassed areas shall be covered evenly with a loose layer of clean wheat, rye, oats, Serecia Lespedeza or Coastal Bermuda Hay. Two tons of dry mulch shall be applied to each acre seeded. Hay shall be placed during calm weather with no wind.

E. As soon as the grass becomes established, a final inspection of the work will be made, provided a written request for such inspection is given to the Engineer. Satisfactory coverage is defined as coverage of the areas seeded with grass that is alive and growing, leaving no bare spots larger than one (1) square foot with 98% coverage.

F. All temporary valves, cutoffs and piping shall be removed by the Contractor at final acceptance of the grassing.

END OF SECTION

B. MECHANICAL SPECIFICATIONS

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SCOPE

Furnish and install the concrete formwork as required by the concrete outlines shown and indicated on the Drawings and specified in this Section, complete.

1.02 FORM DESIGN

Provide the design of all forms for this work. Formwork shall comply with ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, Concrete, Concrete Forms, and Shoring. In addition, the form designs shall meet the requirements of ACI 347.

1.03 SUBMITTALS

A. Do not provide submittals for the structural design of forms.

B. Form Tie Assemblies: Manufacturer's product data sheets fully describing the form tie assemblies.

C. Form Releasing Agent: Manufacturer's product data sheets fully describing the form coating.

D. Plywood Panels: Certification that the plywood panels for use on this work meet the specified standard.

1.04 STORAGE AND PROTECTION

All form materials and accessories shall be stored above ground on framework or blocking, shall be protected from precipitation and shall have adequate air circulation and ventilation.

PART 2 - PRODUCTS

2.01 FORM MATERIAL

A. Smooth Form Finish: Forms for this finish shall be applied to surfaces specified in Section 03300 of these Specifications. Some of these surfaces will receive a rubbed stone finish as specified in Section 03300 of these Specifications.

1. Form facing material shall produce a smooth, dense, uniform texture on the concrete. Form facing shall be one of the following:

a. Plywood, meeting the requirements of U.S. Department of Commerce Product Standard (PS). PS 1 - Construction and

Industrial Plywood, B-B Concrete Form Panels. The arrangement of the facing material shall be orderly with the number of seams kept to a practical minimum.

b. Patented forms may be used, subject to acceptance by the Engineer, provided they produce a smooth, even surface. This acceptance is for the finish these forms will leave on the contact surfaces and will not relieve the Contractor of the responsibility for the design and structural soundness of the forms. Patented forms shall be lined with the specified plywood. Plywood panels and form liners shall not be used more than three times unless further use is acceptable to the Engineer.

B. Rough Form Finish: Forms for this finish shall be applied to the surfaces specified in Section 03300 of these Specifications. Forms for this finish may be the same as specified for the Smooth Form Finish or may be constructed of used plywood panels, unlined steel forms or straight dressed lumber.

2.02 ACCESSORIES

A. Form ties for use in all liquid containment structure walls shall be one of the following:

1. Form clamp assemblies with smooth tie rods with a waterstop at their centers; or “she bolt” tie assemblies with a waterstop at their centers.

2. Both of the assemblies shall permit tightening of the forms and be of such type that leaves no tie metal, or any other tie material, within 1-1/2-inch of the surface after use. The assemblies shall provide cone-shaped depressions at the surface of the concrete at least 1-inch in diameter to allow filling and patching with the specified grout.

B. Form ties for use in all other walls shall be one of the assemblies specified in Article 2.02, paragraph A., except that waterstops are not required.

C. Form releasing agents for liquid containment vessels in water treatment plants shall be equal to Sealtight Duogard by W.R. Meadows.

D. Form releasing agents shall permit coating the concrete surface without additional surface preparation.

E. Form releasing agents shall be a non-staining form coating compound.

PART 3 EXECUTION

3.01 FORM CONSTRUCTION

A. Formwork shall be in accordance with ACI 347 and as follows:

1. Forms shall conform to shape, lines and dimensions of members indicated and shall be sufficiently rigid and tight to prevent leakage of mortar. Forms shall be properly braced or tied together so as to maintain position and shape. Construct forms so that they can be removed readily without hammering or prying against the concrete. Forms for exposed concrete shall be carefully made and accurately placed to obtain correct shape and lines.

2. Joints shall be butted tight. Arrangements of panels shall be orderly and symmetrical and use of small pieces shall be avoided. Forms shall be chamfered 1-inch for external corners of concrete, including top of walls, which will be exposed to view in the finished work.

3. Provide adequate formwork in its entirety. Forms shall safely support loads they will sustain and shall maintain their dimensional and surface correctness to produce members required by the Drawings. Form ties shall be spaced close enough to avoid bulges and variations in the required cross-sectional dimensions shown on the Drawings for the members being cast.

4. Box out for chases, recesses or other openings required in the completed work.

5. Install all the items (sleeves, inserts, hangers, anchors, etc.) to be supported by the formwork as required by the work.

6. Install pipe sleeves, wall pipes and wall sleeves, as shown or specified, for all piping penetrating walls and slabs. The use of block-outs in walls is prohibited. Pipe sleeves shall be used in slabs for plumbing pipes and wiring conduits.

7. Provide a sufficient number of cleanout doors at the base of walls and columns to facilitate cleaning and the application of grout to the column bases.

8. The use of reinforcing steel, partially embedded in concrete, as toe pins or form spacers is prohibited.

3.02 TOLERANCES FOR FORMED SURFACES

A. Variation from Plumb

1. In the Lines and Surfaces of Columns, Piers, Walls:

a. In any 10 Feet of Height: 1/4-inch (walls 1/2-inch).

b. Maximum for the Entire Height: 1-inch.

2. For Exposed Corner Columns, Construction and Expansion Joint Grooves and Other Conspicuous Lines:

a. In any 20 Foot Height: 1/4-inch.

b. Maximum for the Entire Height: 1/2-inch.

B. Variation from the Level or from the Grades Shown on the Drawings:

1. In Slab Soffits, Beam Soffits and Tops of Slabs, Measured Before Removal of Supporting Shores:

a. In any 10 Foot Length: 1/4-inch.

b. In any Bay or in any 20 Foot Length: 3/8-inch.

c. Maximum for the Entire Length: 3/4-inch.

2. In Exposed Lintels, Sills, Parapets, Horizontal Grooves, and Other Conspicuous Lines:

a. In any Bay or in any 20 Foot Length: 1/4-inch.

b. Maximum for the Entire Length: 1/2-inch.

C. Variation of the Linear Building Lines from Established Position in Plan and Related Position of Columns, Walls, and Partitions:

1. In any Bay: 1/2-inch.

2. In any 20 Foot Length: 1/2-inch.

3. Maximum for the Entire Length: 1-inch.

D. Variation in the Sizes and Location of Sleeves for Plumbing Pipes and Electrical Conduits, Floor Openings and Wall Openings: +1/4-inch.

E. Variation in Cross-Sectional Dimensions of Columns and Beams and in the Thickness of Slabs and Walls: -1/4-inch, +1/2-inch.

F. Variation in Sizes of Pipe Sleeves, Wall Pipes and Wall Sleeves: None.

G. Variation in Location of Pipe Sleeves, Wall Pipes and Wall Sleeves: +1/8-inch.

H. Footings

1. Variations in Dimensions in Plan: -1/2-inch, +2-inches.

2. Misplacement or Eccentricity: Two percent of the footing width in the direction of misplacement but not more than: 2-inches.

3. Thickness: Decrease in specified thickness - none; increase in specified thickness 25 percent unless otherwise approved by the Engineer.

4. Tolerances above apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels, or embedded items.

I. Variation in Steps

1. In a Flight of Stairs:

a. Rise: +1/4-inch.

b. Tread: +1/4-inch.

2. In Consecutive Steps:

a. Rise: +0-inch, -1/8-inch.

b. Tread: +1/8-inch.

3.03 Application of Form Coating

Before the placing of reinforcing, faces of all forms to be in contact with the concrete shall receive a thorough coating of the liquid form-releasing agent specified, applied in compliance with the manufacturer's instructions.

3.04 Inspection

Inspect all the work in accordance with Section 03300 of these Specifications.

3.05 Removal of Forms

A. Forms shall be removed in a manner that will ensure the complete integrity of the structure. The forms and shoring shall remain in place for the following minimum periods of time after the casting of the concrete is completed:

	Form Removal, Days	Shoring, Days
Beams and Slabs (Soffits)	7	14
Walls	1	0
Columns	1	0

B. Formwork for beam and slab soffits shall be designed so that they can be removed without removal of sufficient original shores to adequately support the

work until such time that the concrete strength reaches its specified 28-day strength.

C. Removal of forms shall be coordinated with the selected specified method of curing concrete.

D. Wood forms shall be completely removed from all the work to avoid termite infestation.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SCOPE

Furnish and install the concrete reinforcement as shown and indicated on the Drawings and specified in this Section, complete in place.

1.02 SUBMITTALS

A. SHOP DRAWINGS

1. All shop drawings shall be of the same size. Reproductions of the Drawings for use as shop drawings is not permitted. Shop drawings shall include placing drawings, bending details, and bar lists with bar marks. All details and notes appearing on the Drawings, giving information for the placing of reinforcing steel, shall be shown on the shop drawings. Shop drawings will not be reviewed without such information.

2. Wall reinforcing shall be shown in elevation.

3. Show location and size of all penetrations greater than 6-inches in diameter or across the opening with the corresponding added reinforcing around the penetrations.

4. Submittals shall be complete for each structure. Partial submittals are not permitted and will be returned unmarked. Each submittal shall clearly indicate the structure and Drawing numbers that the work is for. The identifying numbers of the shop drawings for each structure shall be in numerical order.

5. Location and arrangement of accessories shall be clearly indicated.

6. All shop drawings shall be checked by the fabricator and Contractor before being submitted to the Engineer. The shop drawings shall bear clear indication that they have been reviewed and approved by the Contractor.

B. Mill tests of reinforcing steel shall be submitted prior to use for each 15 tons or less shipped to the site. Tests shall be conducted in conformance with ASTM A 615, and methods prescribed therein.

1. Cost of mill tests shall be borne by Contractor.

2. Three copies of each test report stating whether the material meets the requirements of the ASTM specifications shall be submitted to the Engineer.

3. Certified copies of the mill tests may be considered evidence of compliance provided such tests are regularly conducted by the reinforcement supplier by experienced, competent personnel using adequate testing equipment. In case of doubt as to the adequacy or accuracy of the mill tests, the Engineer may require the Contractor to furnish, at no additional cost to the Owner, test results from an independent testing laboratory acceptable to the Engineer on mill samples or delivered steel reinforcement.

PART 2 PRODUCTS

2.01 REINFORCING BARS

A. Bar reinforcement shall be deformed-type bars conforming to ASTM A 615. Reinforcement shall be manufactured from new billet steel of American manufacture, Grade 60.

B. Reinforcing steel for welded connections conform to ASTM A706. Welding procedure shall conform to ANSI/AWS D1.4 “Structural Welding Code – Reinforcing Steel.” Do not tack weld.

C. Reinforcing steel shall be shop fabricated to shapes and dimensions indicated on the Drawings and in compliance with applicable provisions of ACI 315 and ACI 318.

D. Bars shall be bent cold. Bars shall be pre-fabricated to detail and delivered on the job plainly tagged and ready to set.

2.02 WELDED WIRE FABRIC

Welded wire fabric shall be in flat sheets conforming to ASTM A 185, with wire conforming to ASTM A 82.

2.03 ACCESSORIES

A. All chairs and bolsters shall have plastic-covered or galvanized steel legs at formed slabs and beams. For slabs on grade, bare metal is acceptable.

B. For slabs on grade 10-inches or less, all reinforcing shall be supported on chairs and/or bolsters as required to properly position the bars or welded wire fabric. The chairs and/or bolsters shall be supported on precast concrete pads bearing on the subgrade. The concrete pads shall be at least 6 x 6-inches and be no more than 1-1/2-inches thick. Pads shall be cast from Class "A" concrete or from mortar made up of one part cement and two parts sand, with tie wires embedded.

C. For slabs on grade greater than 10-inches, reinforcing shall be supported directly on concrete brick bearing on the subgrade or the system noted above for slabs 10-inches or less.

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

Reinforcing steel delivered to the site, not immediately placed in forms, shall be protected from mud and excessive rust-producing conditions by storing in a well-drained area and supported off the ground. All reinforcing shall be properly tagged with their bar marks and location in the structure clearly noted.

3.02 TOLERANCES

A. Allowable tolerances for fabricating steel reinforcement shall be as follows:

Item	Maximum Tolerance, Inches	
Sheared Length of Bars	+1	-1
Depth of Truss Bars	+0.0	-1/2
Outside Dimensions of Stirrups, Ties and Spirals	+1/2	-1/2
Location of Bends	+1	-1

B. Allowable tolerances for placing steel reinforcement shall be as follows:

Item	Maximum Tolerance, Inches	
Concrete Cover from Outside of Bar to Finished Surface	+1/4	-0.0
Lateral Spacing of Bars in Plane of Reinforcement in Beams and Joists	+1/4	-0.0
Lateral Spacing of Bars in Plane of Reinforcement in Slabs and Walls	+1	-1
Spacing of Stirrups, Ties and Spirals Along Longitudinal Axis of Member	+1/2	-1/4
Height of Bottom Bars in Slabs, Beams and Joists	+1/4	-1/4
Height of Top Bars in Slabs, Beams and Joists Depth 8" and Less Depth 9" - 24" Depths 25" & Greater	+1/4 +1/2 +1	-1/4 -1/2 -1

3.03 FIELD FABRICATION

Field fabrication of reinforcing steel is not permitted.

3.04 PLACEMENT AND ANCHORAGE

A. Space metal chairs, bolsters, spacers, and hangers in accordance with ACI 315.

B. Reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce bond. Bars with kinks or bends not shown on the plans shall not be used.

C. Reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position with not less than 16-gauge annealed wire or suitable clips at intersections. Reinforcement shall be held securely at the required distance from the forms. Nails shall not be driven into outside forms to support reinforcement.

D. Install welded wire fabric reinforcement for concrete slabs on ground and as otherwise indicated. Lap all joints 6-inches and wire securely. Extend mesh to within 2-inches of sides and ends of slabs. Sheets that do not lay flat when in their intended position will be rejected. Tags designating the wire size and spacing shall be left on each sheet until ready for use. Tuck ends of welded mesh well down into edge of beams or walls. Do not leave unreinforced border strips. Welded wire fabric shall not contain loose rust. All welded wire fabric shall be supported and tied in its proper location.

E. Conduits: Where conduits are permitted in slabs, low conduit shall be wired to the upper side of bottom reinforcing and top conduit shall be wired to lower side of top steel. Where parallel conduits occur, they shall be separated by at least 2-inches clear.

3.05 CONCRETE COVER

Reinforcement shall be protected by concrete cover as shown and noted on the Drawings.

3.06 SPLICING

A. Splicing of reinforcement shall be as shown and indicated on the Drawings. Splices not shown on the Drawings shall be Class "B" splice, in accordance with ACI 318. Any changes to the location and type of splices desired by the Contractor must be specifically requested and must meet with the acceptance of the Engineer before they can be used.

B. Splices shall not be made at point of maximum stress and shall provide sufficient lap to transfer stress between bars by bond.

C. Mechanical splices may be used instead of lap splices provided that their location and type meet with the acceptance of the Engineer.

D. No more than 50% of horizontal wall reinforcing shall lap in a single vertical plane.

3.07 INSPECTION

Inspect all the work in accordance with Section 03300 of these Specifications.

END OF SECTION

SECTION 03250
CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SCOPE

The work under this Section includes, but is not necessarily limited to, furnishing, and installing all concrete accessories as indicated on the Drawings, herein specified, and as necessary for the progress and complete performance of this work.

1.02 SUBMITTALS

The waterstop manufacturer shall submit documented test results demonstrating that the waterstop will not permit water leakage when subjected to pressure and joint movement.

1.03 QUALITY ASSURANCE

The waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.04 STORAGE AND PROTECTION

Store waterstops under tarps to protect from oil, dirt, and sunlight.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Waterstops for construction joints shall be Greenstreak Waterstop Style 732 or 724 manufactured by Greenstreak, St. Louis, Missouri (or approved equal).

B. Waterstops for expansion joints shall be Greenstreak Waterstop Type 732 as manufactured by Greenstreak, St. Louis, Missouri (or approved equal).

2.02 MATERIALS AND CONSTRUCTION

A. Waterstops

1. Waterstops shall be extruded from an elastomeric plastic compound of which the basic resin shall be prime virgin polyvinyl chloride meeting U.S. Army Corps of Engineers Specification CRD-C572. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

2. Provide factory installed hog rings, grommets, or embedded wire loop to facilitate tying off waterstop at 12-inches on center along the length of the waterstop.

3. Provide factory made PVC waterstop fabrications for all changes of direction, intersections and transitions, leaving only straight butt joint splices for the field.

B. Dovetail Slots

1. No. 22 gauge, galvanized steel, 1-inch wide back.

2. Crimped anchors shall be furnished by other trades whose work abuts concrete.

C. Inserts for General Trades

1. Malleable iron, strength as required.

2. Include bolts, nuts, and washers.

D. Expansion Joint Filler

1. Asphalt impregnated fiberboard, ASTM D 1751, for interior work.

2. Self-expanding corkboard, ASTM D 1752, for exterior work.

E. Construction Joint Form for Building Floor Slabs on Grade: 16-gauge, tongue and groove galvanized metal.

F. Control Joint Form for Building Floor Slabs on Grade

1. 20-gauge galvanized steel.

2. Depth shall be 1/4 the slab thickness or more.

G. Flashing Reglet: 26-gauge galvanized steel. Coordinate with waterproofing subcontractor.

2.03 OTHER MATERIALS

All other materials not specifically described, but required for a complete and proper installation of concrete accessories, shall be as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install concrete accessories as indicated on the Drawings, specified in various other Sections and as necessary for the proper and complete performance of this work.

B. Waterstops

1. Waterstops shall be installed in all construction joints in walls and slabs which are to hold water and also where shown on the Drawings. The waterstop shall extend the entire length of the joint and all splices shall be installed and tested in accordance with the manufacturer's recommendations.

2. Waterstops for all joints shall be continuous around all corners and intersections. For PVC waterstops, provide factory formed corners and intersections where angle intersections occur, and only straight splices shall be made in the field. Splices shall be made in accordance with the manufacturer's recommendations and shall be subject to the approval of the Engineer.

3. No holes will be permitted in waterstops.

4. PVC waterstops shall be securely fastened to formwork or reinforcing steel every 12-inches or less on both edges as required to concrete placement.

C. Piping, Mechanical and Electrical Equipment Support

1. Inserts for hangers will be supplied by the trade whose work is supported.

2. Locations of the inserts shall be given to the Contractor by the various trades.

3. Installation of the cast-in-place inserts shall be by the Contractor.

D. Dovetail Slots: Install dovetail slot at 24-inches on center where masonry adjoins concrete or as noted on the Drawings.

END OF SECTION

SECTION 03300
GENERAL CONCRETE

PART 1 GENERAL

1.01 QUALITY STANDARDS

A. Any procedure and material operation specified by reference to the following publications shall comply with the requirements of the current specification or standard:

1. American Society for Testing Materials (ASTM):

A185 Welded Steel Wire Fabric for Concrete Reinforcement.

A615 Deformed Billet Steel Bars for Concrete Reinforcement.

C31 Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field.

C33 Specification for Concrete Aggregate.

C39 Compressive Strength of Molded Concrete Cylinders.

C94 Specification for Ready Mixed Concrete.

C143 Slump of Portland Cement Concrete.

C150 Portland Cement.

C172 Sampling Fresh Concrete.

C192 Making and Curing Concrete Test Specimens in the Laboratory.

D1751 Preformed Expansion Joint Fillers for Concrete Paving.

2. American Concrete Institute:

ACI 301 Specification for Structural Concrete for Buildings.

ACI 305 Recommended Practice for Hot Weather Concreting.

ACI 318 Building Code Requirements for Reinforced Concrete.

1.02 QUALITY CONTROL

A. The Contractor shall submit to the Engineer, for review a design mix for each class of concrete listed under CLASSES OF CONCRETE, prior to placing any concrete.

B. Verification tests of design mixes and aggregates are required by the Engineer. Verification test specimens shall be made in accordance with ASTM C39 by an

Independent Test Laboratory. Compressive strength shown by verification tests shall be at least fifteen percent in excess of the strengths listed under CLASSES OF CON¬CRETE. The Independent Testing Laboratory shall report the test results to the Engineer, in writing and shall note any failure to meet the specification.

C. Verification tests of design mixes made not more than one year prior to the date of submittal will be acceptable provided they were made from materials identical to those to be used in the project.

D. Mill Test: Conducted in accordance with ASTM A615 recommendations on each 15 tons, or less reinforcing shipped to the job. Two (2) copies of test to be sent to the Engineer.

E. Inspection and Testing of Concrete:

1. The cost of slump tests and sampling, molding, storing, materials, transporting concrete test specimens shall be paid by the Contractor. The laboratory or inspection agency shall be selected by the Owner. Costs of all laboratory testing services required because of failure to meet the requirements of these specifications shall be paid by the Contractor.

2. One set of four (4) acceptance cylinders shall be prepared for each day's placing of each strength of concrete and if more than 50 cubic yards of concrete is placed in any day, there shall be an additional set of cylinders prepared for each 50 cubic yards placed or for any fraction thereof. One cylinder shall be broken at seven days and two at twenty-eight days, with one cylinder held in reserve.

3. Responsibilities in Inspection:

a. Laboratory's Duties

1. The reception and marking of specimens in the laboratory, laboratory curing, preparation for breaking and testing of cylinders shall be the responsibility of the laboratory and shall be performed by qualified laboratory personnel, observing all requirements of applicable ASTM Standards. Compression test specimens shall be tested in accordance with ASTM C39.

2. Prior to the commencement of concrete work, the laboratory shall provide initial instruction in the performance of sampling and testing duties for an employee designated by the Contractor and shall provide him with copies of all ASTM Standards pertinent to his duties.

b. Contractor's Duties:

1. The Contractor shall deliver to the laboratory all materials to be used in required testing. He shall supply

wheelbarrows, shovels, mixing boards, shaded work space and similar equipment required for molding test cylinders. He shall provide stable, insulated storage boxes, equipped with thermostatically controlled heat, for storage of cylinders in the first 24 hours after molding.

2. He shall designate an employee, who alone shall perform all operations of sampling concrete, molding test specimens, protecting test specimens for the first 24 hours after molding, and packing and shipping of test specimens. The employee shall make a record of a slump test in connection with each truckload of concrete. The designated employee shall receive initial instruction in the performance of his sampling and testing duties from a representative of the testing laboratory and shall have available copies of all ASTM Standards pertinent to his duties. Sampling shall conform to ASTM C172. Slump tests shall conform to ASTM C143. Compression test specimens shall be made and cured in accordance with ASTM C31.

3. Each set of test cylinders shipped to the laboratory shall be accompanied by a report giving information as to location in the structure of concrete sampled, time and date of sampling, air temperature, slump, class designated nominal strength, air content if applicable, temperature of concrete, truck number, and time batched. Each report shall be signed by the employee making the test and by the Contractor or his representative, certifying that the test specimens have been made by the one designated, fully instructed employee and have been made in accordance with applicable standard specifications.

4. Should any concrete fail to meet the specified strength, have a slump in excess of that required by the design mix for each class of concrete listed under CLASSES OF CONCRETE, or result in voids, honeycombs or otherwise fail to meet the requirements, the Engineer may order the concrete removed, further tests made, or other remedial measures taken, all at the Contractor's expense.

1.03 SHOP DRAWINGS

A. After making his check the Contractor shall submit to the Engineer one (1) blue line copy of each of placing plans, bending details and bar lists covering all reinforcing steel.

B. Full information for checking and for proper installation without reference to other drawings shall be included. At splices the amount of lap shall be shown. Location and arrangement of accessories shall be clearly shown. Elevations shall be drawn for all reinforced masonry and reinforced concrete walls to a scale no smaller than 1/4 inch = 1 foot.

C. Work shall not proceed before the Contractor has received shop drawings approved by the Engineer. The Contractor shall be responsible for the conformation of all typical and special reinforcing steel details.

D. Engineer's review is for conformance to the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

E. Proposed construction joint shall be clearly indicated on shop drawings and subject to approval of the Engineer.

1.04 INSPECTION

A. The Contractor shall give the Engineer 24 hours advance notice before starting to place concrete in any portion of the structure to permit observation. An authorization of the Engineer shall be secured before concrete is placed. Any concrete placed in violation to this provision shall be replaced by new concrete if required by the Engineer.

B. Prior to notification of the Engineer, the Superintendent shall personally inspect the work and verify that it is ready for observation.

C. At the time of observation, all reinforcing in the area where concrete is to be poured shall be in place, tied and ready for the placement of concrete. All anchors, sleeves, inserts, etc., shall be securely held in position.

1.05 STORAGE

A. Reinforcing steel delivered to the job and not immediately placed in forms shall be placed in racks or other supports at least eighteen (18) inches above ground.

PART 2 MATERIALS

2.01 CEMENT

A. Portland cement shall conform to ASTM C150, Type I.

2.02 AGGREGATES

A. Aggregates for standard weight concrete shall conform to ASTM C33, maximum size: 3/4 inch.

2.03 WATER

A. Mixing water shall be potable.

2.04 REINFORCING STEEL

A. Reinforcing bars shall be American manufactured conforming to the requirements of ASTM A615 "Deformed Billet Steel Bars for Concrete Reinforcement", Grade 60.

B. Welded wire fabric or cold drawn wire for concrete reinforcement shall be of American manufacture and shall conform to the requirements of the ASTM A185 "Welded Steel Fabric for Concrete Reinforcement".

C. Accessories shall conform to the requirements of C.R.S.I. Manual.

2.05 READY MIXED STRUCTURAL CONCRETE:

A. Ready mix concrete shall be mixed and delivered in accordance with these specifications and requirements set forth in ASTM C94. In addition, these following conditions must be met:

1. Concrete shall be normal weight with an ultimate compressive strength at 28 days, and slump as follows:

2. Air entrained concrete shall be used for all structural concrete with the air content not less than 3 percent and no more than 5 percent.

B. Classes of Concrete:

Class A f'c = 3000 psi, Slump 4 inches +/ 1 inch
Class AA f'c = 4000 psi, Slump 3 inches +/ 1 inch
Class B f'c = 5000 psi, Slump 5 inches +/ 1 inch

2.06 EXPANSION JOINT MATERIAL

A. Expansion joint material at slabs on grade shall be premolded asphalt saturated cellulose fiber or mineral strips conforming to ASTM D1751.

2.07 WALL TIES

A. Ties shall be made with break back ends or other means of removing the tie end to a depth of at least 1 inch from the concrete surface after the forms are removed.

2.08 LIQUID FORM SEALER

A. Form sealer shall be a standard product compatible with the finish required for exposed concrete and shall contain no paraffin oil or mineral oil.

PART 3 – EXECUTION

3.01 FORMWORK

A. Forms shall conform to the shapes, lines and dimensions of the members as indicated, and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be braced or tied together so as to maintain position and shape.

B. Formwork shall be observed by the Engineer before pouring concrete. Before placing the reinforcement, surfaces of wood forms in contact with the concrete, unless lined, shall receive a thorough coating of form sealer. The Engineer shall have the right to reject any forms that do not appear to him to be sufficient as to alignment and of producing the required finished surface. Should misalignment of forms or screed, excessive deflection of forms or displacement of reinforcing occur during concrete placing, corrective measures shall be immediately made to the extent, if necessary, that placing operations shall be stopped and concrete removed from within forms. The surfaces to required dimensions and cross section. Exposed lines and surfaces shall not vary from dimensions shown on plans by more than 1/4 inch in twenty feet.

C. Forms may be constructed of wood or metal. Earth forms for footings may be permitted if local conditions are favorable, and approved by the Engineer. Form work for exposed concrete shall be form grade plywood.

D. Studs, waler, and ties shall be so spaced that the load of wet concrete will not stress ties beyond the printed working load recommended by the manufacturer not cause spans of form material to deflect from a true surface.

E. The Contractor shall maintain a continuous check upon formwork during the placing of concrete. An instrument check shall be periodically made or "Tattle Tail" rods or other devices shall be used to detect any settlement in forms.

F. Conduits in Concrete: Conduits shall not displace reinforcing steel from its intended position, nor impair the strength of the structure.

G. The Contractor shall assume all responsibility for removal of formwork. Elevated concrete slabs shall attain 70% of the specified ultimate strength before removing the forms. After removing forms, slabs shall be reshored at mid span and at all points under shores supporting forms for the work above. No floor shall be loaded in excess of the live load for which designed unless adequate shores are place beneath members supporting the concrete of load.

3.02 PLACING REINFORCING STEEL

A. Reinforcement shall be shop fabricated, accurately positioned, and secured with not less than 16-gauge annealed wire or suitable clips.

B. No bars, partially embedded in concrete shall be field bent, unless noted otherwise.

C. Reinforcing bars shall be accurately placed and secured in position by approved chairs, spacers, or ties to maintain the position of the reinforcing steel prior to and during placing of concrete.

D. Reinforcing steel support chairs and bolsters for use in concrete to be exposed shall have galvanized steel leg.

E. No splices shall be made, except as shown on approved Shop Drawings or approved in writing by the Engineer.

F. The placement of reinforcement shall be observed by the Engineer before pouring of concrete. Should there by any delay in the work, reinforcement previously placed shall be reinspected and cleaned, if necessary, before concrete placement is resumed.

G. Metal reinforcement shall be protected by concrete cover. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

Footings	3" clear sides and bottom
Slabs	3/4" clear, top, and bottom
Beams	2" clear, all around
Walls	2" clear, both faces
Columns & Piers	2" clear

H. All splicing or reinforcement not shown shall be approved by the Engineer. Splices shall not be made at a point of maximum stress and shall provide sufficient lap to transfer the stress between bars by bond. Hook and bending details, column tie arrangements, etc., shall be as shown by the S.R.A.I. Manual or the ACI Detail Engineering Manual.

I. Wire mesh reinforcing shall be placed one inch from top of concrete slabs on ground. Lap all joints 12 inches and extend mesh to within 1 inch of sides and ends of slabs.

3.03 CONCRETE MIXING AND PLACING

A. Ready mix concrete shall conform to ASTM C94. Not more than one hour shall elapse between the time mixing water is added to the batch and the concrete is poured. No water shall be added on the job.

B. No concrete shall be placed until all embedded items and reinforcing have been placed in the forms and observed by the Engineer. At least 24-hour notice shall be given the Engineer of an impending pour, so that he may observe the work, prior to placing.

C. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation or loss of materials.

D. Concrete shall be deposited in its final position to avoid segregations and separation do to rehandling or flowing. The placing shall be carried on at such a rate that concrete is at all times plastic and flows readily into the spaces between bars. When placing is once started, it shall be carried on as a continuous operation, until placement of that section is completed.

E. Concrete shall be worked into and around bars and embedded items with spades, rods, trowels, and vibratos, so as to produce a solid homogeneous mass, free of voids, pockets or honeycombs.

F. Construction joints shall be installed and located as indicated. Where a joint occurs, the surface of the concrete shall be thoroughly cleaned and all laitance removed and shall be left rough or mechanically roughened, thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete.

G. All embedded items, including anchor bolts and dowels, shall be in place, preset and held in position, before any concrete is placed.

H. No concreting shall be performed when ambient temperatures are below 40°F or if the temperature is predicted by the local U.S. Weather Bureau will fall below 40°F within 24 hours after the time of installation.

I. No concrete shall be installed against frozen ground. All foundation cavities and slab areas that have frozen, shall be thoroughly clean of all loose earth prior to pouring concrete.

J. All newly poured concrete shall be protected from freezing or near freezing weather during the cure period.

K. Hot weather precautions shall be taken whenever the maximum air temperature exceeds 80°F during the day. Hot weather concreting shall be performed in accordance with ACI 305.

3.04 EXPANSION/CONTROL JOINT INSTALLATION

A. Expansion joints shall be placed a maximum of 20 ft. intervals and at all intersections with steps, curbs other walks or abutting structures. Joints shall extend from the surface to the subgrade at right angles to the sidewalk.

B. Expansion joint filler shall be 1/2 inch thick and as wide as the full width and depth of the sidewalk. All expansion joints shall be filled with semi-rigid epoxy, specifically manufactured for the sealing of control joints in concrete slab construction, to create a water tight slab.

C. Control joints (tooled or saw-cut) shall be placed at no less than 12 and no more than 15 ft. intervals, in a square grid, throughout the full length and width of the concrete slab. All control joints shall be filled with semi-rigid epoxy, specifically manufactured for the sealing of control joints in concrete slab construction, to create a water tight slab.

3.05 ANCHORAGE

A. Slots, inserts, and connections elements for anchoring items to concrete shall be built into forms before placing concrete.

3.06 SLABS ON GRADE

A. Concrete shall be compacted, screeded to grade, and prepared for the specified finish. Slabs shall be placed in panels in alternate checkerboard pattern or in alternate lanes divided into panels. Each panel shall be approximately square terminated by slab joints.

B. Contraction joints shall be true to line 1/8 inch wide, and of depth equal to approximately 1/4 of the slab thickness. Joints shall be sawed or formed.

3.07 CURING

A. Provisions shall be made for maintaining concrete in a moist condition for at least 10 days after the placement of the concrete, or by one of the following methods:

1. Spraying with water or ponding.

2. Using moisture retaining covers.

3. Concrete curing compound, W.R. Meadows CS 309 or Guardian Chemical Co., Master Builders or Triple Cure by Cobra Chemicals.

B. The spraying water shall be applied on unformed surfaces within one hour after the forms are stripped and the spraying shall be continuous. The moisture retain-ing cover shall be applied on unformed surfaces immediately after the concrete is finished. If there is any delay, the concrete shall be kept moist until the application is made. If the surfaces are formed, the forms shall be removed and the concrete sprayed lightly with water before the cover is applied.

C. When concrete surfaces are to receive applied finishes of materials, all curing compounds shall be checked for compatibility with other material to be applied to the concrete surfaces before application.

3.08 CONCRETE FINISHES

A. All poured joints, voids, honeycombs, and other imperfections shall be patched within the same working day that forms are removed.

B. Troweled Finish:

1. Troweled finish shall be applied to the surface of all floors unless ceramic tile, quarry tile or pavers are called for on finish schedule.

2. Floor slabs shall be screened to an even surface by the use of straight edge and screeding strips accurately set to the proper grade. The concrete shall be floated with a wood float in a manner which will compact it and produce a surface free from depressions or inequalities of any kind. Floors shall be level with a tolerance of 1/8 inch in 10 feet except where drains are indicated. After the concrete has hardened sufficiently to prevent fine materials from working to the top and has been allowed to stand until all water sheen has disappeared, it shall be steel troweled. Final troweling shall be done after the concrete is hard enough that no mortar accumulates on the trowel and a ringing sound is produced as the trowel is drawn over the surface. The drying of the surface moisture before troweling shall proceed naturally and shall not be hastened by the dusting on of dry sand or cement.

C. Non slip Finish: All exterior platforms and step treads shall be made non slippery by application at not less than 1/4 lb. per sq. ft. of aluminum oxide or emery aggregate graded from particles retained on a #50 mesh screen to particles passing an 1/8 inch screen placed during the finishing process. Abrasive aggregate shall be sprinkled by hand as soon as the freshly placed cement will support the weight of workmen and floated into the surface.

D. Unfinished Slabs: Depressed slab areas to receive ceramic quarry tile or pavers shall be finished to remove all laitance and to leave a slightly roughened, surface to insure bond. The surface of the slab shall not vary in any direction more than 1/8 inch when tested with a ten-foot straight edge. The straight edge shall be lapped one half its length as the test is being made.

3.09 CONCRETE FLOOR HARDENER

A. All concrete floor slabs shall be cured with concrete floor hardener, "Clear Bond", as manufactured by Guardian Chemical, "Triple Cure: by Cobra Chemicals, or "Sealtight Cs 309 by W.R. Meadows. The floor hardener shall be applied in strict accordance with the manufacturer’s recommendations.

B. Walks shall be tooled, full 1 inch deep into separate slabs as indicated. Surface edges of each slab shall be rounded to approximately 1/4 inch radius.

C. Final finish shall be a medium or light broom finish and all tool marks completely removed.

END OF SECTION

SECTION 03301
CONCRETE FOR BUILDINGS

PART 1 – GENERAL

1.01 Codes with the provisions of the following codes, specifications and standards, except as otherwise shown or specified:

ACI 301 "Specifications for Structural Concrete for Buildings."
ACI 311 "Recommended Practice for Concrete Inspections."
ACI 318 "Building Code Requirements for the Reinforced Concrete."
ACI 347 "Recommended Practice for Concrete Form work."
ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

1.02 SUBMITTALS

A. Laboratory test reports for concrete materials and mix design.

B. Certificate of design conformance.

PART 2 – PRODUCTS

2.01 AGGREGATE

A. Course Aggregate: ASTM designation C33. Maximum nominal course aggregate shall be ½" maximum size for concrete block fill and 1" maximum size for other concrete.

B. Fine Aggregate: ASTM designation C3 washed sand.

2.02 PORTLAND CEMENT

A. Federal Specification SS C 192, Type 1 or ASTM C150 72 Type 1.

2.03 CURING MATERIALS

A. Membrane forming curing compounds: Non yellowing acrylic, resin base or chlorinated rubber base type conforming to Federal Specifications TT C 800 non pigmented.

2.04 AIR ENTRAINING ADMIXTURE

A. ASTM C260

2.05 REINFORCEMENT

A. Bars: Conforming to ASTM designation A615, Grade 60.

B. Mesh: ASTM A185. Welded steel wire fabric.

2.06 WATER

A. Water shall be potable and free from deleterious substances.

2.07 COLD JOINTS

A. Burke keyed cold joint form or equal.

2.08 EXPANSION JOINTS

A. ASTM D1751 Resilient, non extruding, asphalt impregnated fiberboard.

PART 3 – EXECUTION

3.01 FORMWORK

A. Forms shall be designed, constructed and maintained to insure that after removal of forms the finished concrete members will have true surfaces free of waviness or bulges, conforming accurately to the indicated shapes, dimensions, line elevations and positions. Form surfaces that will be in contact with concrete shall be thoroughly cleaned before each use. Forms shall be coated with a chemical form release; non oil, non staining.

B. Form ties shall be factory fabricated, removable or snap off metal ties of design that will not allow form deflection and will not spill concrete upon removal.

C. Exposed external corners shall be beveled or chamfered by moldings placed in the forms.

3.02 REINFORCEMENT

A. Reinforcement shall be fabricated to shapes and dimensions shown and shall be placed where indicated. Reinforcement shall be free of loose or flaky rust and mill scale, or coating including ice and any other substance that would reduce or destroy the bond.

B. Reinforcement detailing and placement including concrete protection for steel reinforcement shall conform to ACI Standard 318 and 315.

3.03 JOINTS

A. Pre-molded expansion joint filler: At expansion joints in concrete slabs to be exposed, pre-molded expansion joint filler strips shall be installed at the proper level.

B. Construction joints other than slabs on grade: Concrete shall be placed continuously so that the unit will be monolithic in construction. Fresh concrete may be placed against adjoining units provided the set concrete is sufficiently hard not to be injured thereby. Joints not indicated shall be made and located to least impair strength and appearance of the structure. Construction joints, if required, shall be located near the midpoint as spans for slabs or beams.

3.04 CONCRETE MIX DESIGNS

A. Concrete mix shall be designed for a 3000 psi compressive strength at 28 days.

B. Mix proportions shall be determined in compliance with ACI Standard 318.

3.05 SLUMP LIMITS

1. 3" maximum slump for slabs and walks.
2. 4" minimum slump for curbs and footings.

3.06 BATCHING AND MIXING

A. Concrete of the ingredients and design mixes shall be measured, batched and mixed at the plant in conformance with ASTM designation C94.

3.07 PREPARATION FOR PLACING CONCRETE

A. Water shall be removed from excavations before placing concrete. Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner

surfaces of mixing and conveying equipment. Reinforcement shall be secured in position.

3.08 PLACING CONCRETE

A. Concrete shall be handled from mixer to transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, without segregation or loss of ingredient until the approved unit of operation is completed.

3.09 DEPOSITING IN COLD OR HOT WEATHER

A. Concrete, when deposited shall have a temperature not below 55°F and not above 90°F. In freezing weather suitable means shall be provided for maintaining concrete after depositing at a temperature not lower than 70°F for 3 days, or 50°F for 5 days after placing, except when high early strength Portland cement or concrete is used temperature must be maintained at not less than 70°F for 2 days or at 50°F for 3 days.

B. Cooling of concrete to outside temperature shall not be at a rate faster than one degree each hour per first day and two degrees each hour thereafter until outside temperature is reached. Methods of heating material and protecting concrete shall be approved by Engineer. Salt, chemicals or other foreign materials shall not be mixed with concrete for the purpose of preventing freezing.

C. Deposit in hot weather (90° and above), take special care in placing concrete during hot weather. Forms must be thoroughly wetted just before concrete is placed and exposed surfaces of concrete shall be kept continually damp by sprinkling for 7 days.

3.10 COMPACTION

A. Immediately after placing, each layer of concrete shall be compacted by internal concrete vibrator supplemented by hand spading, rodding and tamping. Tapping or other external vibration for forms will not be permitted.

3.11 BONDING

A. Before depositing new concrete on concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be retightened. The cleaned surfaces may be moist but shall be without free water when concrete is placed.

3.12 CURING

A. Concrete shall be protected against moisture loss, rapid temperature change, mechanical injury from rain or flowing water for a period of 7 days. Concrete shall be maintained in a moist condition at temperatures above 50°F throughout the specified curing period. Concrete shall be protected from rapid temperature change and rapid drying for the first 24 hours following the removal of temperature protection. Curing shall be accomplished by the following methods:

1. Impervious sheet curing All surfaces shall be thoroughly wetted with a fine spray of water and be completely covered with water proof paper, or poly-ethylene sheeting, or with polyethylene coated burlap having the burlap thoroughly water saturated before placing.

2. Membrane forming compound curing conforming to ASTM C3009 The compound shall be applied on damp surfaces as soon as the moisture film has disappeared. The curing compound shall be applied in a two coat, continuous operation at a coverage of not more than 400 square feet per gallon for each coat. Membrane curing compound shall not be used on surfaces that are to receive any subsequent treatment that depends on adhesion or bonding to the concrete. Non-residual may be used on approval.

3.13 REMOVAL OF FORMS

A. Forms shall be removed in a manner to completely insure the safety of the structure. Forms may be removed after 24 hours, provided the concrete is sufficiently hard not to damage thereby.

3.14 FINISHES AND PATCHING OF CONCRETE OTHER THAN FLOOR SLABS

A. Within 12 hours after forms are removed, surface defects shall be remedied as specified herein. Temperature of concrete, ambient air and mortar during remedial work including curing shall be above 50°F. Fins and loose material shall be removed. Honeycomb, aggregate pockets, voids over ½" in diameter and holes left by the rods or bolts shall cut out to solid concrete, thoroughly wetted, brush coated with neat cement grout and filled mortar. Mortar shall be a stiff mix of 1 part blended Portland and white cements to 2 parts fine aggregate passing the No. 16 sieve and a minimum amount of water. When dry, the color of the mortar shall approximately match the adjoining concrete color. Mortar shall be thoroughly compacted in place.

B. Hand rubbed finish shall be used on 45° sloped exposed concrete.

3.15 FINISHING CONCRETE SLAB SURFACES

A. Trowel finish Immediately after slab is placed, screed top surface of concrete slab, tamp concrete with tamping tools to bring grout to surface. Darby to produce true level. Squeeze off excess water and laitance. Test surface with 10 foot straight edge so that depressions do not exceed 1/4" in center of span of straight edge in any direction. Machine float slabs to proper elevations and allow to stand until all water sheen has disappeared before troweling. Delay finish troweling until concrete is so hard that no mortar accumulates on a trowel and ringing sound is produced as the surface is finished with the trowel. Do not dust cement finishing. Finish surfaces neatly around columns, walls, etc. When finished, slab depression shall not exceed 1/4" in the length of a 10 foot straight edge in any direction.

B. Broom finish slabs Walks and paving Immediately after slab is placed, screed top surface of slab; tamp concrete with jitterbug, darby or wood float to produce true level or sloped smooth finish. After initial set, groom with stiff fiber broom to remove laitance and smooth spots. Repeat brooming the following day. Remove excess material and protect.

3.16 CLEANUP

A. Upon completion of the work, forms equipment protection covering and any rubbish resulting therefrom shall be removed from the premises. Finished concrete surfaces shall be left in a clean and perfect condition, satisfactory of the Engineer.

END OF SECTION

SECTION 03302
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SCOPE

Furnish and install the cast-in-place concrete as shown and indicated on the Drawings and as specified in this Section, complete.

1.02 SUBMITTALS

A. Mix designs for all groups and classes of concrete.

B. Strength and slump tests results.

C. Certificates of compliance for each of the following:

1. Cement
2. Aggregates
3. Fly ash
4. All admixtures

PART 2 PRODUCTS

2.01 CEMENT

Cement shall be standard Portland Cement, of American manufacture, conforming to ASTM C 150, Type I. Only one brand of commercial Portland cement shall be used in the exposed concrete of the structure. Cement reclaimed by cleaning bags or from leaking containers shall not be used in this work. Each bag shall weigh approximately 94 pounds and contain one cubic foot.

2.02 CONCRETE AGGREGATES

A. Fine aggregate shall be sand having clean, hard, durable, uncoated grains and free from deleterious substances and shall conform to ASTM C 33.

B. Coarse aggregate shall be crushed stone having clean, hard, durable, uncoated particles conforming to ASTM C 33.

2.03 WATER

Water used in mixing concrete shall be clean and free from deleterious amounts of acids, alkalies or organic materials.

2.04 EXPANSION JOINT FILLER

See Section 03250 of these Specifications for expansion joint filler.

2.05 WATERSTOPS

See Section 03250 of these Specifications for waterstops.

2.06 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting, minimum 6 mil thickness, conforming to ASTM C 171.

2.07 ADMIXTURES

A. Water reducing admixture shall conform to ASTM C 494, Type A.

B. Water reducing, retarding admixture shall conform to ASTM C 494, Type D.

C. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C 494, Type C.

D. Air entraining admixture shall conform to ASTM C 260.

E. Fly ash shall conform to ASTM C 618, Type F.

F. High range water reducer (HRWR) shall conform to ASTM C 494, Type F or G and shall be one of the following:

1. Rheobuild 1000 and 716, manufactured by Master Builders

2. Daracem 100, manufactured by W.R. Grace

3. Sikament 320, manufactured by Sika Corporation

4. Eucon 37, manufactured by Euclid Chemical Company

G. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are <u>not</u> permitted.

2.08 CURING AND SEALING COMPOUNDS

A. Curing compound shall be acrylic based, conforming to ASTM C 309.

B. Sealing compound shall be one of the following:

1. Masterseal 340, manufactured by Master Builders

2. Sikaguard 70, manufactured by Sika Corporation

3. Super Rez Seal, manufactured by Euclid Chemical Company

PART 3 EXECUTION

3.01 CONCRETE QUALITY

A. Two groups of concretes are required. Group I is concrete with a HIGH RANGE WATER REDUCER (HRWR), Group II is concrete without HRWR.

1. Group I: All Group I concrete shall contain the specified fly ash. The combined weight of cement and fly ash shall contain no less than 20 percent nor more than 25 percent of fly ash. The combined weight of cement and fly ash shall be used as the weight of cement in the determining of the water-cement (w/c) ratio. The following classes of concrete are required:

Class of Concrete	Compressive Strength @ 28 Days	Slump Range	Maximum W/C Ratio
A	4,500	1" - 2"	0.4

a. The slump range in the above table is required prior to adding the High Range Water Reducer (HRWR). Slump tests shall be made prior to adding the HRWR. The HRWR shall be added to the concrete at the batch plant. The slump range required after the addition of the HRWR is 7 to 10-inches. HRWR shall be capable of maintaining 7 to 10-inch slump in excess of 60 minutes of continuous mixing at 4 to 6 rpm in a truck mixer and workability up to 90 minutes. After introduction of HRWR, concrete temperature shall be maintained within 3 degrees F for 90 minutes when concrete temperatures are in excess of 90 degrees F. Except for the air- entrainment admixture, no other admixture shall be used with the HRWR. Upon 72 hours notice, the HRWR manufacturer shall supply jobsite technical service to the Contractor. The manufacturer shall be consulted for mix proportions and dosage rates. No added chlorides shall be used. The initial set shall not be in excess of six hours at temperatures above 50 degrees F. HRWR shall be used with due consideration given to the air temperature at the time of batching and casting.

b. Air Content: All concrete shall have an air content of 4.0 percent to 7.0 percent.

c. Group I concrete shall be used in all walls and columns for liquid containment structures.

2. Group II: The following classes of concrete are required:

Class of Concrete	Compressive Strength @ 28 Days	Slump Range	Maximum W/C Ratio
A	4,000	3" - 5"	0.45
B	3,000	3" - 5"	0.56

a. Air Content: All concrete shall have an air content of 2.5 to 5.0 percent.

b. Admixture Usage: All concrete placed at air temperatures above 50 degrees F shall contain a water reducing admixture or water reducing-retarding admixture. All concrete placed at air temperatures below 50 degrees F shall contain the specified non-corrosive non-chloride accelerator.

c. Group II, Class A concrete shall be used for all work not specified as Group I concrete.

d. Fly ash is required in all slabs for liquid containment structures, either on grade or formed. Provisions for fly ash use in Group I concrete shall apply.

e. The use of fly ash is not required for the remainder of Group II concrete, but is permitted. If used, the provisions for fly ash use in Group I concrete shall apply.

3.02 MIX DESIGNS

A. Mix design shall be proportioned in accordance with ACI 211.1 making maximum use of the coarse aggregate. The proportioning shall be based on the requirements of a well-graded high density plastic workable mix within the slump range and strengths required. The mix shall contain no less than 1,850 pounds of coarse aggregate per cubic yard of concrete, shall be based on conventional conveying and shall not be altered for use in pumping. Pumping equipment, if used, shall be of sufficient size and design to pump the mix designed for conventional conveyance.

B. Coarse Aggregate

1. Coarse aggregate for all concrete in liquid containment structures shall be Size No. 467.

2. Coarse aggregate for all other concrete work shall be Size No. 57.

3. Size No. 467 may be used in lieu of Size No. 57 in concrete members whose minimum size dimension is 8-inches or larger.

C. If trial batches are used, the testing laboratory shall make strength tests from trial batches in the laboratory using materials and mix designs proposed for use by the Contractor. The testing laboratory shall prepare trial batches in accordance with ACI 211.1.

D. If field experience method is selected, the proposed mix design shall be accompanied by complete standard deviation analysis and at least 30 consecutive strength test that represent the proposed mix. The strength tests shall have been performed within 12 months of submittal.

E. The proposed mix design and supporting data shall be submitted, in triplicate, to the testing laboratory for their review and comments at least 21 days prior to the expected start of concreting operations. The testing laboratory will forward

two copies of the submittal to the Engineer with their comments. The Engineer will review the submittal and return one copy to the Contractor with the Engineer's comments.

F. Compression test specimens made to verify the mixes shall be made in accordance with ASTM C 192. All compression test specimens shall be tested in accordance with ASTM C 39.

3.03 PLANT MIXING

A. Proportioning Concrete

1. Proportions shall be in compliance with approved design mix for each class of concrete.

2. The mixing plant shall be provided with adequate equipment and facilities for accurate measurement and control of the quantities of material and water used in the concrete.

3. Concrete materials shall be measured by weight except that admixture shall be measured by volume.

B. Batching

1. Provide all necessary equipment to accurately determine and control actual amount of materials entering into the concrete mix. Individual ingredients shall be weighted separately for each batch. Accumulative weighing will be allowed if equipment is in acceptable working order as determined by the testing laboratory and approved by the Engineer. Accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount.

2. Completely discharge contents of the mixer before each new batch is loaded. Use of retempered concrete is not permitted.

3. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of ASTM C 94 and the following:
   a. A separate water metering device (not truck tank) shall be used for measuring water added to the original batch.

   b. Use of wash water as a portion of the mixing water is not permitted. Wash water added to empty drums after discharging shall be dumped before a new batch is received.

   c. Centrally mixed concrete shall be mixed for the length of time specified herein, not “shrink-mixed”

   d. Mixing drums shall be watertight.

e. Concrete shall be discharged within one hour from the time concrete was mixed, if centrally mixed, or from time the original water was added, if transit-mixed.

f. Furnish delivery ticket with each load of concrete delivered under these Specifications. Delivery ticket shall show clearly the class and strength of concrete, size of coarse aggregate, water per cubic yard, its slump, quantities of all admixtures, the date and time of departure from the batching plant, and the time of placement.

3.04 CONVEYING EQUIPMENT

A. If concrete is to be transported in carts or buggies, the carts or buggies shall be equipped with pneumatic tires.

B. Equipment for chuting or other methods of conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at delivery without segregation of concrete.

3.05 CONVEYING

A. Concrete shall be conveyed from mixer to place of final placement by methods which will prevent separation or loss of the material.

B. Runway supports shall not bear upon reinforcing steel or fresh concrete.

C. All conveying equipment shall be thoroughly cleaned before each run of concrete is begun.

3.06 DELIVERY AND PROTECTION OF MATERIALS

A. Deliver ready-mixed concrete in compliance with requirements of ASTM C 94.

B. The following tests shall be made at the work site prior to placement of concrete:

1. Slump Tests: ASTM C 143.

2. Air Content: ASTM C 173 or C 231

3. Test Cylinders: ASTM C 31

3.07 SEVERE-WEATHER PROVISIONS

A. Hot Weather Concreting: Protect in accordance with ACI 305R except as modified herein.

1. Provide adequate methods of lowering temperature of concrete ingredients so that the temperature of concrete when placed does not exceed 90 degrees F.

2. Concrete shall not be placed when the air temperature is expected to exceed 100 degrees F within 12 hours after casting.

3. When the air temperature is 75 degrees F and above, forms and reinforcing shall be thoroughly wetted with water so that the concrete will be placed against wet and cooled surfaces. All excess water shall be removed before casting the concrete.

4. Protection and Curing - Slabs (On Grade and Formed)

    a. Protect slabs from damage due to dry winds and high temperatures.

    b. Protect slabs from direct sun at temperatures of 85 degrees F and above.

    c. Moist curing of all slabs shall start as soon as the surface of the fresh concrete is hard enough to permit curing without damage to the surface of the concrete.

5. Protection and Curing - Formed Surfaces: As soon as the concrete has set, wet the forms, and keep the forms wet during the curing period. Provide for keeping the top of the walls, and other top surfaces, moist during the curing period.

B. Cold-Weather Concreting: Protect in accordance with ACI 306R except as modified herein.

1. Provide adequate equipment for heating concrete materials and protecting concrete from damage during freezing or near-freezing weather. No frozen materials, or materials containing ice, shall be used.

2. All concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come into contact shall be free from frost.

3. Whenever the temperature of the surrounding air is below 40 degrees F and falling, all concrete placed in the forms shall have a temperature of between 70 and 80 degrees F, and adequate means shall be provided for maintaining a temperature of not less than 70 degrees F for three days, or 50 degrees F for five days, or for as much more time as is necessary to insure proper curing of the concrete. If high early strength concrete is used, the requirement for maintenance of 50 degrees F may be reduced to three days.

4. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

5. Housing, covering, or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heat is discontinued.

3.08 CONSTRUCTION JOINTS AND EXPANSION JOINTS

A. Formed Construction Joints in Containment Structures and Where Otherwise Shown: Prior to placing concrete next to the joint, the joint surface shall be thoroughly cleaned and dampened with water. Remove all free water so that the surface of the joint shows signs of drying before placing the adjacent concrete.

B. Construction joints in Beams, Girders and Slabs Where Waterstops are not Specified or Shown to be Installed: These joints shall be located at points of minimum shear and their locations shall be approved by the Engineer before they are bulkheaded. These joints shall be roughened and thoroughly cleaned of all foreign matter and laitance and dampened with water. Remove all free water and slush with a coat of neat cement grout before placing the adjacent concrete. Place the adjacent concrete before the neat cement grout takes its initial set.

C. Construction Joints in Beams, Girders and Slabs: Where waterstops are specified or shown to be installed. These joints shall be treated as specified in paragraph A. above.

D. Construction Joints in Columns: These joints, unless otherwise shown on the Drawings, shall be located at the bottom of the girder, beam or slab it receives, and at the top of slabs when the column continues through a slab level. These joints shall be treated as specified in paragraph B. above.

E. Expansion Joints: Expansion joints shall be installed where shown on the Drawings.

3.09 WATERSTOPS

Waterstops shall be provided where specified and as indicated and noted on Drawings and shall be made continuous throughout their length.

3.10 INSPECTION OF WORK BEFORE PLACING CONCRETE

A. Inspect the area to receive concrete for any deficiencies which would prevent proper placing of concrete. Do not proceed with placing concrete until such deficiencies are corrected.

B. Do not place in the concrete any item that is not required to be in the concrete by the Drawings and Specifications. Insert all the items shown on the Drawings or specified properly positioned and secured. Openings other than those which are facilitated by sleeves shall be properly formed and positioned.

C. Remove hardened, or partially hardened, concrete on forms or reinforcement before placing concrete.

D. Do not place concrete on earth until the fill or excavation has been prepared as set forth under applicable sections of the Specifications for that work.

E. Give the Engineer at least 48 hours notice before any concrete is to be placed. Concrete shall not be placed until the Special Inspector has performed all applicable inspections listed and described in Table 1705.3 of the 2012 edition of the International Building Code. In addition to the inspections required by Table 1705.3, the special inspector shall also certify that the formwork, reinforcing, and all inserts required for mechanical and electrical work, instrumentation, plumbing, process piping, metal embeds, and any other inserts or miscellaneous specialties required for the work are supported in their proper position. The Special Inspector shall certify that the formed enclosure is clean, and the surfaces to receive concrete are prepared as specified. The Special Inspector shall be employed by the owner and shall submit reports as soon as is practicable after work has been inspected. Report issuance shall conform to section 1704.2.4 of the 2012 IBC.

3.11 PLACING

A. Place concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not place concrete on work that has partially hardened or been contaminated by foreign material, and do not use retempered concrete. In no case shall Group II concrete be placed when the elapsed time after addition of water and cement to batch exceeds one hour. For Group I concrete, this elapsed time may be extended if sufficient data from this construction indicates a time extension is permissible and if approved by the Engineer.

B. Concrete shall be placed in a manner to avoid the displacement of reinforcing, and coating or spattering the reinforcing steel. The placing of concrete within form work shall be regulated so that the pressure within form work does not exceed the design pressure. In placing concrete each layer shall be placed following the preceding layer to prevent lines of separation or “cold joints” in the work. After the concrete reaches it initial set, jarring the formwork or placing strain or vibration on the ends of projecting reinforcing bars shall be avoided.

C. Group I concrete shall not be dropped more than 10 feet. Group II concrete shall not be dropped more than four feet. All concrete placed over PVC waterstops shall drop no more than 6-inches until there is at least one foot of concrete above the PVC waterstop, at which point the drop distances may be increased to those noted above.

D. Once concrete placing has started, it shall be carried on as a continuous operation until placing of the concrete between construction joints is completed.

E. Concrete shall be placed in layers not over 12-inches deep and each layer shall be compacted with the aid of mechanical internal-vibrating equipment supplemented by hand spading. Vibrators shall in no case be used to transport concrete. Use of form vibrators are not permitted. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the concrete. At least one spare working vibrator shall be on the job site as a

back-up. Duration of vibrator use shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrator shall not be lowered into courses that have begun to set. Apply vibrator at uniformly spaced points not further apart than the visible effectiveness of the machine. Type and use of vibrators shall be in accordance with ACI 301.

F. Provide vapor barrier under all building slabs on soil, sand, or stone. Use largest sheets practicable to reduce number of joints. Lap joints a minimum of 24-inches. Remove torn and punctured sheets and replace with new sheets prior to placing concrete. Placing of concrete shall be done in a manner that will not damage the vapor barrier material. The sub-base material shall be as shown and/or noted on the Drawings.

3.12 PROTECTION

Protect freshly placed concrete from damage or injury due to water, falling objects, persons or anything that may mar or injure finish surface on concrete. Only light use of slabs will be permitted for the first 14 days after placing of the concrete.

3.13 CURING

A. Curing shall conform to ACI 308 except as modified herein.

B. All Slabs on Grade: After placement and finishing, concrete shall be maintained in a moist condition for at least seven successive days during which the temperature of the concrete is 50 degrees F or above. For temperatures of 50 degrees F and below, curing period shall be 14 successive days. Concrete shall be kept moist by any one, or combination, of the following methods:

1. Ponding or Immersion: Continually immerse the concrete in water throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

2. Fog Spraying or Sprinkling: Provide uniform and continuous application of water throughout the curing period.

3. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6-inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

4. Impervious Sheeting: Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12-inches minimum. Provide sheeting not less than 18-inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Inspect surface of concrete daily for

wetness. The surface shall be kept continuously wet during the curing period.

C. All Other Concrete: After placement, concrete shall be maintained in a moist condition for the same periods as specified above for slabs on grade.

1. Concrete in Formed Surfaces - Slabs, Beams, Columns and Building Walls: Keep forms and exposed surfaces wet with water during the curing period. If forms are removed before the end of the curing period, apply a curing compound within one hour after form removal.

2. Concrete in Formed Surfaces - Containment Vessel Walls: Keep forms wet with water during the curing period. If forms are removed before the end of the curing period, continue the moist curing in accordance with Paragraph A. of this article of these Specifications.

3.14 PATCHING

A. As determined by the Engineer, any concrete which is out of alignment or level, has a defective surface or has defects which reduce its structural adequacy, shall be considered as not conforming with the Drawings and Specifications and shall be rejected.

B. Do not take any remedial action on concrete with any defect without the permission of the Engineer.

C. Unless the Engineer grants permission to patch the rejected concrete, remove the rejected concrete and replace it with concrete that conforms to the Drawings and Specifications. The location of cut lines and the extent of removal will be determined by the Engineer.

D. If the Engineer grants permission to patch the rejected concrete, it shall be done in accordance with the following:

1. Permission to patch rejected concrete will not be a waiver of the Engineer's right to require complete removal of the rejected concrete if the patching does not, in the Engineer's judgement, restore the concrete to the requirements of the Specifications and Drawings.

2. Patching shall be accomplished after the curing is completed.

3. Defective areas shall be chipped away to a depth of not less than 1-inch, in all cases to sound concrete, with edges perpendicular to the surface. Feather edges will not be permitted. Remove all loose material and thoroughly clean the chipped surfaces with a high pressure air hose delivering air at 100 psi. The area to be patched and an area at least 6-inches wide surrounding it shall be dampened. A bonding grout shall be prepared using a mix of approximately one part cement to one part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surfaces as noted below in paragraph 5.

4. The patching mixture shall be made of the same materials and of approximately the same portions as used for the original concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to two and one-half parts sand by damp, loose volume. White Portland cement shall be substituted for a part of the gray Portland cement to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

5. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be kept damp for seven days. Finishing tools that produce a finish matching the surrounding shall be used.

E. Tie holes left by withdrawal of rods or the holes left by removal of ends of wall ties shall be filled solid with mortar after first being wetted. For holes passing through the wall, a plunger-type grout gun shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing through the walls shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth. Mortar shall consist of one part cement, two and one-half parts sand and no more water than necessary for handling and packing.

3.15 FINISHES ON FORMED SURFACES

A. Upon completion of patching, surfaces of concrete shall be finished as follows:

1. Brushed Finish Surface Coating

a. The brush finish surface coating shall be applied over a Smooth Form Finish (see Section 03100).

b. The materials used shall be applied in two separate coats to provide a uniform finish on exposed surfaces that have received the initial rubbed finish. The materials shall be mixed and applied strictly in accordance with the written recommendations of the product manufacturer. The actual application of the material shall be performed by workers who have been instructed in the preparation and application of the material. The final brushing of the material during application shall be performed in such a

manner as to present a uniform and attractive appearance, with the final brushing generally being done in one direction. The materials shall be especially manufactured for the purpose of waterproofing exterior concrete surfaces, and enhancing the appearance of the concrete surface. The final color of the finish shall be pearl gray, or near that of good quality cured natural concrete. Texture of material shall be approved by the Engineer. Material shall be Thoroseal as manufactured by Thoro System Products.

c. The following surfaces shall receive a brushed finish surface coating:

i. All exterior wall concrete surfaces to levels not less than 6-inches below finish grade.

ii. All interior wall concrete surfaces within buildings and other such surfaces exposed to view in the finished work (except floor slabs).

iii. The interior side on containment tank walls to a level not less than 12-inches below normal liquid level, including top of walls.

2. Smooth Form Finish is required for all concrete surfaces exposed to view in the completed work and all liquid containment structure walls whether exposed to view or not in the completed work. Accomplish the required patching and the following touch-up:

a. Remove all burrs.

b. Remove all form marks.

c. Smooth out lines of indentations.

3. Rough Form Finish shall be produced by filling all tie holes and honeycomb and in other respects leaving the surface as formed. All concrete surfaces which will be covered by earth and which will not be visible in the completed structure (except as noted above for liquid containment structure walls which shall have a Smooth Form Finish), may receive a Rough Form Finish.

3.16 STEEL TROWELED FINISH - FLOOR SLABS

A. Steel troweled finish shall be applied to the surface of all building and liquid containment structure floor slabs and interior equipment pads.

B. Concrete shall be placed, consolidated, struck-off and leveled to the proper elevation. After the surface has stiffened sufficiently to permit the operation and the water sheen has disappeared, the surface shall be wood floated, by hand or

power floated, at least twice, to a uniform sandy texture. Floors shall be leveled such that depressions between high spots do not exceed 1/4-inch under a 10-foot straightedge except where drains occur, in which case the floors shall be pitched to the drains as indicated on the Drawings.

C. After the concrete has received a wood float finish, it shall be troweled at least twice to a smooth dense finish. The drying of the surface moisture before floating or troweling shall not be hastened by the dusting on of dry sand or cement. The first troweling shall be done by a power trowel and shall produce a smooth surface relatively free of defects. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be free of any trowel marks or other imperfections; shall be uniform in texture and appearance, and shall be in true plane within the tolerance specified. Any deviation from this condition which remains after the troweling is completed shall be corrected by grinding.

3.17 BROOM FINISH

A. Broom finish shall be applied to:

1. All exterior sidewalks, walkways, and platforms.

2. All steps and landings, both interior or exterior.

B. The surface shall be given a floated finish as specified above, then finished with a flexible bristle broom or burlap belt drawn across the surface. Surface must be hardened sufficiently to retain the scoring or ridges. Scores or ridges shall be transverse to traffic or at right angles to the slope of the slab.

3.18 SURFACE PREPARATION FOR FINISH GROUT

The surface shall be given a wood float finish and moist cured. After the curing period, the finish grout shall be applied where indicated and noted on the Drawings.

3.19 TESTING LABORATORY

A. The testing laboratory shall have access to all places where concrete materials and concretes are manufactured, stored, proportioned, mixed, placed and tested. Duties shall include, but not necessarily be limited to the following:

1. Make, store, transport, cure, and test compression specimens made during placing of concrete. Compression test specimens shall be tested in accordance with ASTM C 39. Test reports shall show all pertinent data, such as class of concrete, exact location of pour, air temperature, date of pour, time of pour, truck number for ready-mixed concrete, date on which specimen was broken, age of specimen, compressive strength of specimen, concrete slump test results and air content of concrete from which the specimen was made. One copy each of all tests shall be sent to the Contractor and two copies each to the Engineer.

2. Each strength test requires four standard test cylinders.

3. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 75 cubic yards of concrete, nor less than once for each 5,000 square feet of surface area for slabs or walls.

4. Each class of concrete shall be tested with at least five strength tests.

5. From each set of four cylinders, two shall be tested at 28 days and shall comprise a strength test under the definition of these Specifications. One cylinder shall be broken at seven days and will be used as an aid in determining the early strength of the concrete and the 28 day strength, and one cylinder retained in reserve for later testing if required.

6. Test for unit weight of concrete when the first load of each class of concrete is delivered and thereafter at the discretion of the testing laboratory.

B. Periodically inspect the batching plant and file a report with the Engineer stating whether the supplier's equipment and methods meet the requirements of these Specifications.

C. Temperature and Placing Record: Temperature record shall be made each day during the concreting operations. Records shall also include location, quantity and starting and finishing time of placement for all concrete work. Copy distribution shall be as specified above for test reports.

3.20 Evaluation of Compression Tests

A. Evaluation of compression test results shall be as follows: For each class of concrete, compression-strength tests for laboratory-cured cylinders shall be considered satisfactory if the averages of the results of all sets of three consecutive compression-strength tests equal or exceed the 28 day design compression-strength specified; and, no individual cylinder strength test falls below the required compression strength by more than 500 psi. Strength tests of specimens cured under field conditions may be required by the Engineer to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by the field-testing laboratory at the same time and from the same samples as the laboratory-cured specimens.

B. Faulty Concrete: Failure to comply with any of the specified conditions shall constitute faulty concrete. Unless otherwise directed by the Engineer, faulty concrete shall be removed and replaced with concrete as specified, at no expense to the Owner.

C. Additional Test: If permitted by the Engineer, additional tests shall be subject to the approval of the Engineer and at no expense to the Owner. Load tests, if permitted by the Engineer, shall be conducted in accordance with the loading criteria as required bythe design of the structure, as determined by the Engineer.

D. Neither the results of laboratory verification tests nor any provision in the Contract Documents shall relieve the Contractor of the obligation to furnish concrete of the class and strength specified.

END OF SECTION

SECTION 03602
NONMETALLIC GROUTING

PART 1 GENERAL

1.01 SCOPE

This Section describes nonmetallic grout and grouting methods to be used in the setting of motors, compressors, pumps, aerators, vessels, tanks, pipe supports, structures and other miscellaneous items of equipment that require grout between their baseplate, bedplate or soleplate and the top of the concrete surface to which they are to be anchored.

1.02 GENERAL

A. The Contractor shall furnish all labor, grouting materials, water, equipment, forms and other items necessary or convenient to the Contractor for the proper preparation, placement and curing of grout.

B. Non-shrink, epoxy and sand-cement grouts shall be stored, mixed, handled and placed in accordance with the recommendations of the grout manufacturer and the American Concrete Institute (ACI), as applicable.

C. No grout shall be placed until the place of grouting has been inspected and approved by the Engineer.

1.03 SUBMITTALS

A. Prior to placement of any non-shrink or epoxy grout, the Contractor shall submit to the Engineer complete engineering and product data on the grout, including manufacturer's recommendations for mixing, placement and curing.

B. The Contractor shall also submit to the Engineer written evidence that the grout, cement and aggregate is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the grout, cement and/or aggregate supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or Corps of Engineers testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of grout, cement and/or aggregate.

1.04 STORAGE

All grout shall be stored above ground and shall be protected at all times from moisture, high humidity, oil and extremes of temperature. Grout or cement which has been resacked or has become caked or lumpy shall not be used.

1.05 SAFETY

Proper precautions shall be taken to protect workers during handling of epoxy resins and hardeners. All mixing and placement of epoxy grouts shall be done in well-ventilated areas. The specific safety recommendations of the manufacturer shall be strictly adhered to.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT

Column baseplates, all pumps, compressors, motors, and other heavy equipment items shall be grouted in place with a nonmetallic, noncorrosive, nongaseous, non-shrink grout requiring no cutback or protective coating. Non-shrink grout shall show zero shrinkage from the placement volume or initial expansion volume as determined by ASTM C 827, and shall have an initial set time at 70 degrees F of not less than 45 minutes as determined by ASTM C 191. When tested in accordance with ASTM C 109, non-shrink grout shall have a one-day compressive strength of not less than 2,000 psi and a 28-day compressive strength of not less than 8,000 psi at a flow of not less than 100 percent determined in accordance with Corps of Engineers Specification CRD-C-621. The grout shall contain no corrosive irons, calcium chloride, oxidizing catalysts, gas-forming agents, harmful aluminum, or corrosive chemicals and shall be resistant to oil, water, and sewage. The grout shall be premixed and shall require only the addition of water prior to placement. The grout shall be delivered to the job site in unopened, plastic-lined bags and shall have the manufacturer's mixing instructions printed on the back of each bag. Non-shrink grout shall be Masterflow 928 Grout as manufactured by Master Builders Company, or Five Star Grout as manufactured by Five Star Products, Inc.

2.02 SAND-CEMENT GROUT

A. Pipe support baseplates, tanks and miscellaneous small items of equipment shall be grouted in place using a sand-cement grout consisting of one part Portland cement, two parts fine aggregate and a maximum of 4.5 gallons of water per sack (cubic foot) of cement. Portland cement shall be Type III conforming to ASTM C 150. Fine aggregate shall be natural siliceous sand, consisting of hard, clean, sharp, dense, durable, and uncoated particles.

B. Fine aggregate shall be free from organic material and injurious amounts of deleterious substances and shall be graded as follows:

Sieve Size No.	Percent (by weight) Passing
4	100
8	95 - 100
16	60 - 100
30	35 - 70
50	15 - 35
100	2 - 15

C. Except as modified herein, fine aggregate shall conform to the requirements of ASTM C 144.

D. Fine aggregate to be used with epoxy binders shall be dried prior to use to remove any free moisture.

2.03 NONSHRINK EPOXY GROUT

Non-shrink epoxy grout shall be used in special equipment grouting applications requiring high bonding or tensile strength where shown on the Drawings. This grout shall be a pre-measured and prepackaged product containing thermosetting epoxy resins and inert fillers; and shall be delivered to the work site in unopened containers. Non-shrink grout shall be Ceilcote 648 CP Grout (Master Builders, Inc.) or Five Star Epoxy Grout (Five Star Products, Inc.).

2.04 WATER

Water used in the preparation of non-shrink and sand-cement grout shall be clean, potable water, free from oil, alkali, acid, organic matter, and other deleterious substances.

PART 3 EXECUTION

3.01 FOUNDATION PREPARATION

A. Prior to setting equipment or placing grout, the foundation to receive grout shall be chipped or sandblasted so as to expose the coarse aggregate and create a roughened condition. All surfaces to be in contact with the grout, including the bottom of the baseplates or sole plates, shall be thoroughly cleaned until free of all oil, grease, laitance, dust, curing compounds and other foreign substances If the surface is to receive non-shrink or sand-cement grout, the roughened surface shall be washed with liberal amounts of clean water and shall be soaked for a least 24 hours immediately preceding grouting. Prior to placement, all free water shall be removed using an air hose or other suitable method.

B. Surfaces to receive an epoxy grout shall be completely dry and free from all visible moisture. Where it is impractical to obtain a moisture-free surface, the Engineer may authorize the use of epoxy grout on damp surfaces provided the epoxy formulation is moisture-compatible. When applying grouts to damp surfaces all free water shall be removed and the epoxy formulation shall be carefully selected so that localized boiling of entrapped moisture due to excessive exotherm does not occur.

3.02 MIXING

A. The specific recommendations and instructions of the grout manufacturer shall be strictly adhered to in all proportioning, mixing and placing of grout. The grout shall be mixed as close to the point of use as is practical. A mechanical mortar mixer may be used for mixing large quantities of non-shrink or sand-cement grout. No more grout shall be mixed than can be placed in the time preceding

initial set. Grout that has stiffened prior to placement shall be discarded. Only that amount of water required to produce the necessary degree of flowability shall be used. The grout mixture shall not be retempered by adding water.

B. Components of epoxy grout systems shall be accurately proportioned and thoroughly mixed so as to produce a uniform and homogeneous mixture. Accuracy of proportioning of epoxy compounds shall be + five percent of the manufacturer's specified mixing ratio. Mixing of small quantities (up to one quart) of epoxy grout may be accomplished by hand using spatulas, palette knives, or similar devices. For larger volumes, mechanically driven tumbling or paddle type mixers shall be used. Paddle type mixers shall be driven by a low speed (400-600 rpm) motor to prevent introduction of excessive amounts of entrained air into the mixture. Mixing shall continue until the mixture is uniform and homogeneous, but in no case less than three minutes. The manufacturer's recommended temperature range for mixing the epoxy grout shall be followed in all field mixing.

C. After mixing, epoxy grout shall be allowed to stand for approximately five minutes to allow initial air release.

3.03 PLACEMENT

A. Grout shall be carefully placed by troweling, ramming, or pouring, as is most suited to the application, so that all voids and cavities between the foundation and equipment baseplate or bedplate are filled. Air-relief holes shall be provided, if necessary, to eliminate entrapped air. If a pourable or flowable grout is required, suitable forms shall be provided for containing the grout. Forms shall be securely anchored and caulked to prevent leakage of grout. Grout shall be placed from one side only. Forms shall be of sufficient height to allow at least 6-inches of head on the grout above the bottom of the baseplate on the side where the grout is to be placed. Grout shall be placed until it protrudes from the entire perimeter area. Baseplates shall be located so as to provide a minimum clearance of 1-inch between the foundation and the bottom of the baseplate. The temperature of the foundation and baseplate or soleplate shall be maintained above 45 degrees F during placement and for at least 24 hours thereafter. Heating of foundation and baseplate surfaces shall be accomplished using heated enclosures, heat lamps or radiant heaters so as to achieve uniform heating. Use of direct flame shall be prohibited. Concrete structures shall be heated a minimum of four hours prior to grouting to ensure proper heating of the concrete mass. Temperature of heated surfaces shall not exceed 100 degrees F at the time of placement. When placing nonshrink or sand-cement grout under unusually hot or cold weather conditions, grouting practices shall comply with the requirements of ACI 305 and 306, respectively.

B. Epoxy grout formulations shall possess exotherm properties compatible with the anticipated substrate and placement conditions. Where large masses of epoxy are involved or if ambient or substrate temperatures are high, relatively low exotherm formulations shall be used. Conversely, where very small quantities or thin films of epoxy are involved or if ambient or substrate temperatures are low, a high exotherm formulation shall be used.

C. When placing epoxy grouts by pouring, care shall be taken to ensure that segregation of aggregate and epoxy binder or entrapment of entrained air does not occur prior to initial set. To prevent this condition, epoxy grout shall be placed in successive lifts under the baseplate or bedplate not to exceed 1-inch in thickness.

3.04 FINISHING AND CURING

A. Forms shall be left in place until the grout is hardened enough so that it cannot flow. Unconfined edges of grout shall be cut off flush or beveled and shall be troweled to produce a smooth finish. Wedges and shims used in levelling rotating, vibrating or other heavy items of equipment shall be removed after the grout has hardened three days. All voids shall be regrouted using the same grouting material. Removal of shims and wedges from column baseplates and pipe support baseplates is optional. Anchor bolts shall not be pulled up to final torques until shims and wedges have been removed and the grout is hard enough to permit equipment operation.

B. After placement, exposed edges of water-cured grout shall be wet cured by covering with wet burlap, wet sand, or polyethylene film for at least seven days. During cold weather grout shall be maintained at a temperature for a period of time following placement that will ensure proper hardening and curing.

END OF SECTION

SECTION 04100
MASONRY MORTAR

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment and material required to ensure the proper proportioning of materials for masonry mortar and related work as described herein and or shown on the Drawings.

1.02 SUBMITTALS

Product Data: For each different masonry mortar product specified, Submit to ME Sack Engineering.

1.03 STORAGE AND PROTECTION

A. Cementitious materials shall be delivered to the site in unbroken bags or other approved containers, plainly marked and labeled with the manufacturer's name and brand.

B. Cementitious materials shall be handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness.

1.04 QUALITY ASSURANCE

A. Materials shall conform to the current editions of the following standards:

1. Masonry Cement: ASTM C91.

2. Aggregate for Masonry Mortar: ASTM C 144.

3. Portland Cement: ASTM C 150, Type I.

4. Hydrated Lime for Masonry Purposes: ASTM C 207, Type S.

5. Mortar for Unit Masonry: ASTM C 270.

B. The Contractor shall submit to the Engineer written evidence that the cement, lime, and aggregate is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the cement, lime and/or aggregate supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of cement, lime and/or aggregate.

C. In addition to these submittals, the Contractor shall submit to the Engineer test results in compliance with ASTM C 270, Section 9 for each type of mortar to be used in the work. The test report shall also include the average compressive strength of three 2-inch cubes of laboratory prepared mortar. Mortar mix ingredients and proportions shall not be changed during the course of the work without the Engineer's approval. Extreme care shall be taken to assure that the same proportion of each ingredient is used in each batch. Mortar color shall be proportioned by weight in individual containers prior to mixing. Measuring mortar color by volume during mixing shall not be allowed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Masonry Cement

1. Masonry cement shall be a mixture of Portland cement and Type S hydrated lime. The mix shall not contain inert or noncementitious mineral fillers. If package mix is used, other hydraulic cements may be substituted for a part of the Portland cement. However, the Portland cement shall not be less than 30 percent of the total. Packaged mixes shall conform to the requirements of ASTM C 91.

2. The composition of the masonry cement shall be printed on each bag in terms that show compliance with these requirements.

3. If a packaged mix is not used, the Portland cement shall conform to ASTM C 150, Portland Cement, Type I and hydrated lime shall conform to ASTM C 207, Type S. The hydrated lime may be used in dry or paste form.

B. Sand: Aggregate for use in masonry mortar shall be clean, free from salt or other deleterious materials and conform to ASTM C 144, Aggregate for Masonry Mortar.

C. Water: Water for mixing shall be potable, clean, and free from oil, acids, salts, and other deleterious matter.

D. Color:

1. Masonry cement used in interior non-load bearing smooth face CMU wall construction shall be grey.

2. Masonry cement used in the split faced CMU veneer shall be colored. Colors shall be submitted to the owner (via ME Sack Engineering) for approval.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mixing and Placing

1. All mortar materials shall be accurately measured by volume and thoroughly mixed until they are evenly distributed throughout the batch. Mix mortar as follows: first, add approximately 3/4 of required water, 1/2 the sand and all the cement and lime; mix and add remainder of sand. Mix briefly; then add remainder of water in small quantities until workability of batch is satisfactory to masons. Mortar color when used shall be added to the 3/4 of required water prior to adding sand. After all materials have been added, mix for a minimum of five minutes. Completely empty drum before recharging for next batch.

2. All mortar shall be mixed in a powered, batch-type mechanical mixer. This requirement will not be waived except for minor jobs and then only upon the approval of the Engineer.

3. Mortars mixed for more than one hour shall not be used. A mortar which shows a tendency to become dry before this time shall have water added to it and shall be re-mixed. The use of a continuous mixer or retempered mortar shall not be permitted.

4. Mortar for pointing shall have integral waterproofing added in accordance with the manufacturer's instructions.

B. Mix Proportions: All mortar shall conform to the requirements of ASTM C 270 and shall conform to section 2103.9 of the 2012 IBC.

1. Mortar Uses

a. Use Type S for all load bearing masonry and in foundation walls where masonry materials occur.

b. Use Type N for all interior non-load bearing masonry.

c. Use Type S for all face brick work, backup and parging.

d. Type M may be used in lieu of Type N or S.

e. Type S may be used in lieu of Type N.

END OF SECTION

SECTION 04200
MASONRY

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide all labor, materials, equipment and services required for complete execution of masonry work as shown on drawings and specified herein.

B. Related work specified elsewhere:

1. Section 07900: Caulking and Sealants

1.02 PROJECT HANDLING

A. All masonry units shall be stacked on raised pallets or platforms so that they will not be in contact with the ground.

B. While stacked on the job, masonry units shall be covered and protected with a waterproof covering.

C. Any straw used for packing shall be removed from the units before they are stacked on the job site.

D. All partially completed walls not being worked on shall be protected at all times by a waterproof covering. This includes covering of incomplete walls at the end of each day for overnight protection.

E. Use only wooden bodied wheelbarrows for conveying masonry units. The use of metal bodied wheelbarrows shall not be allowed.

PART 2 – PRODUCTS

2.01 CONCRETE BLOCK

A. Hollow Concrete Blocks: Grade N. units to meet ASTM C90 75.

B. Solid Concrete Blocks: Type II, grade N units to meet ASTM C145 75.

2.02 MORTAR

A. Mortar shall be Grade M or Grade S.
B. Masonry Cement: ASTM Designation.
C. Portland Cement: ASTM Designation C150 74.
D. Sand: ASTM Designation C144 76.
E. Water: Fresh, clean and free from acid, alkalies, sewage or organic matter.
F. Mixing:
    1. Shall be in accordance with ASTM C270 73.
    2. Shall be by mechanical means.
    3. Mortar shall be used and placed in final position within 2½ hours after mixing.
    4. Keep proportions constant.

2.03 MASONRY ACCESSORIES

A. Continuous Joint Reinforcement:
    1. Joint reinforcement with wall ties shall be standard galvanized truss type.
    2. Approved Manufacturers: Masonry Reinforcing Corporation of America; Dur O Wall; A.A. Wire Products Co.; Hohmann & Barnard Inc., or Heckman Building Products, Inc.

PART 3 – EXECUTION

3.01 MASONRY WORK

A. Mortar joints shall be concave.

B. Bond all concrete block masonry with continuous wall reinforcement at 16" o.c. forming corners and intersections.

3.02 INSTALLATION

A. Lay all masonry work in sizes and percentages as outlined.

B. Lay concrete block in running bond.

C. Provide full mortar bed smooth or slightly furrowed. Butter ends of all masonry units with mortar to fill head joints.

D. Lay no masonry units during freezing weather or when the temperature is forecast to go below freezing within 24 hours.

E. All masonry units work shall be laid true to dimension, plumb, square and in bond and anchored with vertical joints in line plumb and true.

F. No exposed, broken, chipped or cracked units allowed.

G. Build in grounds, conduits, switch boxes, anchors and nailing blocks.

H. Form chases, slots and patch masonry work for all trades.

I. Bond or tie with reinforcement all intersections of masonry walls.

J. Take care to wipe all exposed masonry units with rough cloth or brush as work progresses to prevent mortar stains.

K. Flashing: Furnished by sheet metal section unless otherwise noted on drawings. Place by this section where it is to be built into masonry.

L. In laying all masonry units avoid over plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has been set, the mortar shall be removed and replaced with fresh mortar.

M. Leave cavities clean of all mortar droppings.

N. When intersecting walls are carried up separately tooth or block the perpendicular joints with no more than 8" off sets.

3.03 POINTING AND CLEANING

A. At the completion of the work, all holes or defective mortar joints in exposed masonry shall be pointed and all defective joints shall be cut out and repointed.

B. Exposed masonry shall be protected against staining from wall covering or other sources and excess mortar shall be wiped off the surface as the work progresses.

C. All exposed masonry shall be cleaned at the completion of the work by the application of Sure Klean #101 lime solvent. Protect exposed concrete walls by masking and taping with a 4 mil. polyethylene film. Apply in accordance with manufacturer's detailed instructions printed on or attached to each container. Approved manufacturers: Acme Brick Co. DC 6 Brick Cleaner.

END OF SECTION

SECTION 04220
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SCOPE

A. The work covered by this Section consists of furnishing all labor, equipment and material required for the correct placement and construction of concrete masonry units and related work as described herein and/or shown on the Drawings.

B. Work for Other Trades: Bolts, anchors and shelf angles shall be the responsibility of the Contractor. However, the subcontractors requiring such work are responsible for furnishing complete information to the Contractor.

1.02 SUBMITTALS

Certification: Furnish manufacturer's written certification accompanied by suitable laboratory or mill test reports that masonry units furnished meet or exceed the requirements of these Specifications.

1.03 STORAGE AND PROTECTION

Store masonry units above ground on level platforms which allow air circulation under stacked units. Cover and protect against wetting prior to use. Handle units on pallets or flatbed barrows. Do not permit free discharge from conveyor units or transporting in mortar trays.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete block shall have 8 x 16-inch face with 4, 6, 8, 10 or 12-inch nominal width, as required.

B. Hollow masonry units shall comply with “Specification for Hollow Load-Bearing Concrete Masonry Units,” ASTM C 90, Grade N. Hollow masonry units shall be one of the following:

1. Light weight, concrete weighing less than 105 pcf. Minimum net compressive strength of 1,900 psi.

C. Architectural Concrete Masonry Units: Provide Concrete Block load bearing units in accordance with Article 2.01, Paragraph A. of this Section manufactured by Metromont, with water repellant admixture. Nominal face dimensions 8 x 16-inches; thickness as indicated; external corners square with two finished faces. Minimum compressive strength shall be 1,900 psi. Provide all special shapes as

required to complete concrete masonry work, including wraparound corner units.

D. Color: Provide colored masonry units, as indicated on the Drawings, by Metromont.

2.02 CONCRETE BRICK

Concrete brick shall comply with “Specifications for Concrete Building Brick,” ASTM C 55, Grade N.

2.03 REINFORCEMENT

A. Block wall reinforcement shall be of the prefabricated type for use in masonry mortar joints. Wall reinforcement shall be of ladder design for composite wall construction with No. 9 gauge deformed hot-dipped galvanized side rods and No. 9 gauge galvanized cross rods. Joint reinforcement shall comply with “Standard Specification for Cold Drawn Steel Wire for Concrete Reinforcement”, ASTM A 82.

B. Dovetail anchors shall be hot-dipped galvanized steel, triangular shaped wire tie, sized to extend within 1-inch of masonry face complying with ASTM A 82.

2.04 WEEPHOLE MATERIAL

Weepholes shall be absorbent rope made from cotton, 1/4 to 3/8-inch in diameter in length to produce 18-inches in cavity of 4-inch cmu veneer.

PART 3 EXECUTION

3.01 ERECTION AND WORKMANSHIP

A. Scaffolding shall be provided, as required. Scaffolding shall not be overloaded and shall be inspected regularly by the Contractor to verify that it is amply strong, well braced, and securely positioned. The Contractor shall be always unconditionally responsible for the safety of the scaffolding.

B. Masonry shall not be laid when the temperature is below 40 degrees F. Walls shall be carried up level and plumb all around. Unfinished work shall be stepped face for joining with new work; toothing shall not be permitted. Heights of masonry shall be checked by the Contractor with an instrument at each floor and at sills and heads of openings to maintain the level of the walls.

C. Masonry units shall be handled with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by qualified masons. Masonry shall be cut with a masonry saw outside of buildings. Chipping or breaking with a hammer will not be permitted.

D. Door and window openings, louvered openings, anchors, pipes, ducts, and conduits shall be built in carefully as the work progresses. Ties and anchors shall be placed accurately. Metal work specified elsewhere shall be placed in position as the work progresses. Grouting of ties and anchors into hardened mortar or grout shall not be permitted.

E. Masonry units shall be laid in running bond. The first course of masonry shall be laid in a full bed of mortar; and the succeeding courses shall be shoved (not laid) in beds of mortar to fill the joints full without subsequent flushing and filling. Unless shown or specified otherwise, all joints shall be 3/8-inch thick. Where ties, anchors and bolts occur within the cells of the units, such cells shall be filled with mortar or grout as the work progresses.

F. Concrete masonry units shall be dry when laid. Each unit shall be adjusted to final position in the wall while the mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and re-laid with fresh mortar. Vertical cells to be filled with grout shall be aligned to provide a continuous unobstructed opening of the dimensions shown. Chases shall be plumb and shall be minimum one unit length from jambs of opening.

G. Exterior or exposed masonry joints shall be finished with smooth concave contour. Procedure used in striking joints shall be as follows: first strike the bed joints; next strike the head joints; then strike bed joints as required to remove any spots, etc., from intersection of bed and head joints. After mortar has initial set but before mortar is hard, restrike the head joints to provide clean, smooth intersection of the head and bed joints. Interior and exterior joints to receive masonry coating shall be tooled flush.

H. At the end of each day's work, the tops of exposed masonry walls shall be covered with a strong, nonstaining waterproof membrane well secured in place. Surfaces not being worked on shall be properly protected at all times. Unfinished work shall be stepped for joining with new work. Before new work is started, all loose mortar shall be removed and the exposed joint thoroughly wetted, not less than 30 minutes before laying new work.

I. Control joints shall be installed where concrete masonry units abut dissimilar materials and shall be installed vertically in exterior walls at 30 feet on center, unless shown otherwise on the Drawings.

3.02 WALL REINFORCEMENT

A. Place wall reinforcement in first masonry bed joint above finished floor and in alternate bed joints (16-inches on center) thereafter.

B. Masonry joint reinforcement shall be placed so that longitudinal wires are located over face shell mortar beds and are fully embedded in mortar for their entire length with minimum mortar cover of 5/8-inch of exterior side of walls and 1/2-inch at other locations. Reinforcement shall be placed in first and second bed joint above and below openings. Reinforcement in the first bed joint immediately above and below openings shall be continuous. In the second bed joint it shall extend two feet beyond each side of the opening.

C. Reinforcing shall be lapped a minimum of 6-inches at splices. Corner and abutting wall reinforcement shall be prefabricated corner and tee sections.

3.03 CLEANING

A. During construction, care shall be taken to keep exposed face of masonry clean of mortar and other stains. Joints shall be raked as they reach thumbprint hardness. The exposed work shall then be brushed with a soft fiber brush to remove adhering mortar. A wooden paddle shall be used to remove more tenacious material. Bases of walls shall be protected from splash stains by covering the adjacent floor or ground with sand, sawdust, or polyethylene film.

B. At completion of work, holes in exposed masonry shall be pointed and defective joints shall be cut out and tuck pointed solidly with mortar.

C. If necessary, exposed masonry surfaces shall be scrubbed with warm water and soap and fiber brush and thoroughly rinsed with clear water. Work which may be damaged, discolored or stained shall be protected during the cleaning process. The use of sapolio or wire brushes or acid for washing down walls shall not be permitted.

D. Protect all finished work against freezing, for a period of not less than 48 hours, by means of enclosures, temporary heat or such other protective methods as may be required and directed by the Engineer.

3.04 WEEPHOLES

Install Weepholes in head joints in exterior wythes of first course of masonry immediately above embedded flashing.

END OF SECTION

SECTION 04230
REINFORCED UNIT MASONRY

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment, and materials required for the correct placement and construction of reinforced masonry units and related work as described herein and/or shown on the Drawings.

1.02 ADDITIONAL REQUIREMENTS

Requirements of Section 03200 of these Specifications apply to work of this Section.

1.03 SUBMITTALS

A. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel required for the Project.

B. Shop Drawings: Submit shop drawings for fabrication, bending and placement of reinforcement bars. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

1.04 Product Delivery, Storage, and Handling

Store masonry units above ground on level platforms which allow air circulation under stacked units. Cover and protect against wetting prior to use. Handle units on pallets or flatbed barrows. Do not permit free discharge from conveyor units or transporting in mortar trays.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Refer to Section 04220 of these Specifications for masonry accessories not included in this Section.

B. Reinforcement: Provide deformed bars of following grades complying with ASTM A 615, except as otherwise indicated.

C. Shop fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 EXECUTION

3.01 PLACING REINFORCEMENT

A. Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1-inch, whichever is greater.

C. Splice reinforcement bars where shown. Do not splice at other points unless acceptable to the Engineer. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Provide not less than the minimum lap indicated, or if not indicated, as required by governing code.

D. Anchoring: Anchor reinforced masonry work to supporting structure as indicated. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.02 Installation, General

A. Refer to Section 04220 of these Specifications for general installation requirements of unit masonry.

B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

C. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete, if any. Brace, tie, and support as required to maintain position and shape during construction and curing of reinforced masonry.

D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.

1. Ten days for girders and beams.

2. Seven days for slabs.

3. Seven days for reinforced masonry soffits.

3.03 Installation of Reinforced Concrete Unit Masonry

A. General:

Do not wet concrete masonry units (CMU). Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8-inch joints.

B. Walls:

1. Pattern Bond: Lay CMU wall units in running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells or cells of non-reinforced vertical cells, or provide units with solid bottoms.

4. Brace walls against wind and other forces during construction. Allow sufficient time between lifts to preclude displacement of solid masonry units or cracking of face shells of hollow masonry units. If blowouts, misalignment, or cracking of face shells should occur during construction, tear down and re-build the wall.

C. Grouting:

1. Use “Fine Grout” per ASTM C 476 for filling spaces less than 4-inches in one or both horizontal directions.

2. Use “Coarse Grout” per ASTM C 476 for filling 4-inch spaces or larger in both horizontal directions.

3. Grouting Technique: Use low-lift grouting techniques subject to requirements which follow:

a. Provide minimum clear dimension of 2-inches and clear area of 8 square inches in vertical cores to be grouted.

b. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bars diameters nor 10 feet.

c. Lay CMU to maximum pour height. Do not exceed five feet in height or if bond beam occurs below five feet height, stop pour at course below bond beam.

d. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2-inches below top course of pour.

e. Bond Beams: Stop grout in vertical cells 1-1/2-inches below bond beam course. Place horizontal reinforcing in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

END OF SECTION

SECTION 05120
STRUCTURAL METALS

PART 1 GENERAL

1.01 SCOPE

A. This Section covers all items fabricated from metal shapes, plates, sheets, rods, bars, or castings and all other wrought or cast metal except component parts of equipment and items covered by other sections.

B. Fabricated metal items, which are detailed on the Drawings but not mentioned specifically therein, shall be fabricated in accordance with the applicable requirements of this Section.

C. Division 13 Section “Pre-Engineered Metal Buildings”.

1.02 FACTORY TESTING

A. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory. Payment for such services will be made by the Contractor. If approved by the Engineer, certified tests performed by the manufacturer's testing laboratory at no cost to the Owner will be acceptable.

B. If so desired by the Engineer, inspection of the fabrication shall be made at the place of manufacture. Access shall be permitted to all places where the work is being done.

1.03 SUBMITTALS

A. Detailed shop drawings, product data sheets and erection and installation details for miscellaneous metal items shall be submitted in accordance with Section 01340 of these Specifications.

B. All shop drawings shall be of the same size. Reproductions of the Drawings for use as shop drawings is not permitted. Submittals shall indicate thickness, type, grade, class of metal, dimensions and shall show construction details, reinforcement, anchorage, welds, fasteners, and installation with relation to other construction.

C. Submittals shall be complete for each structure. Partial submittals are not permitted and will be returned unmarked. Each submittal shall clearly indicate the structure and Drawing numbers that the work is for. The identifying numbers of the shop drawings for each structure shall be in numerical order.

D. All shop drawings shall be checked by the fabricator and Contractor before being submitted to the Engineer. The shop drawings shall bear clear indication that they have been reviewed and approved by the Contractor.

E. Welding certificates.

1.04 STORAGE AND PROTECTION

A. Store structural metals above ground on platforms or other supports and protect from weather with suitable covering. Do not permit water ponding or moisture collection on stored items.

B. Handle steelwork to prevent damage to members and to shop paint coat and to prevent accumulation of mud, dirt, or other foreign materials capable of interfering with field paint application.

1.05 QUALITY ASSURANCE

A. Structural steel manufacturers shall provide written certification to the Engineer that all materials furnished comply with all applicable requirements of these Specifications.

B. Welding: Qualify procedures and personnel according to AWS Specifications for steel and aluminum welding.

C. Steel: Comply with applicable provisions of the following Specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges".

2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2".

3. AISC's "Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design".

4. AISC's "Specification for the Design of Steel Hollow Structural Sections".

5. AISC's "Specification for Allowable Stress Design of Single-Angle Members."

6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

PART 2 PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

A. All materials shall be new and undamaged and shall conform to pertinent AISC, ANSI, ASTM, or other industry standards. Unless specified otherwise in other sections, all materials in fabricated metal items shall conform to the following requirements:

1. Structural steel shapes shall conform to ASTM A992 Fy: 50 ksi.

2. Steel plates and bars shall conform to Specifications of Structural Steel ASTM A 36.

3. Structural steel tubing shall conform to ASTM A 500 Grade B. Steel pipe ASTM A53, Type E or S, Grade B.

4. Stainless steel shall conform to the following AISI Type 304 for sheets and plates; AISI Type 316 for bolts and stainless steel items in corrosive areas.

5. Galvanizing shall be hot dipped in accordance with Specifications for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plate, Bars and Strip ASTM A 123.

6. Gray cast iron shall conform to ASTM A 48, Class 30B.

7. Ductile iron shall conform to ASTM A 536, Grade 65-40-18.

8. Aluminum alloy shall conform to the following Aluminum Association Specifications and designations:

6061-T6	Structural Shapes, Tubes and Pipes in Corrosive Areas, Sheets, Plates, Wire, Rods, Bars, Bolts and Screws
6063-T6	Tubes and Pipes in Non-Corrosive Areas
6066-T6	Weldings and Extrusions
6151-T6	Forgings and Forging Stock

9. High strength steel bolts, nuts and washers shall conform to ASTM A 325.

10. All embedded anchor bolts or anchor bolt materials shall be ASTM A 193, Grade B8; ASTM A 276, Type 304; or IFI-104, Grade 304 stainless steel, threaded per ANSI B1.1. Nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern and shall be ASTM A 194, Grade 8 or IFI-104, Grade 304 stainless steel. Flat washers shall be 18-8 stainless steel and shall conform to ANSI B27.2.

11. Electrodes for welding structural steel shall conform to “Specification for Mild-Steel Covered Arc-Welding Electrodes”, AWS A5.1, E-70 series. Electrodes for welding aluminum shall conform to AWS A5.10.

B. Stairs and Platforms: Stairs and platforms shall be fabricated from steel conforming to ASTM A 36 and shall be hot dipped galvanized after fabrication, unless noted otherwise. Stair and platform design, fabrication and installation shall conform to OSHA regulations.

C. Checkered Floor Plates: Unless otherwise shown, checkered floor plates shall be 6061-T6 aluminum alloy with raised diamond pattern on the upper surface. Floor plate shall have a minimum thickness of 1/4-inch and shall be designed for a deflection of not more than 1/300 of span under a uniform load of 100 pounds per square foot. However, in no case shall the thickness of the floor plates be less than that shown on the Drawings for the specified clear span.

D. Welding and Brazing - General

1. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous and where exposed to view shall be ground smooth. All continuous welds shall be gas and liquid-tight. Intermittent welds shall have an effective length of at least 2-inches and shall be spaced not more than 6-inches apart.

2. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Welding Code shall also apply to welded aluminum structures. The welding process and welding operators shall meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding and Section 328, Brazing and Soldering. All costs associated with the qualification or testing of welders and welding operators shall be borne by the Contractor.

3. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor's expense. Excessive porosity, non-metallic inclusions, lack of fusion, incomplete penetration and cracking shall constitute grounds for rejection of welds.

E. SHOP FABRICATION

1. Structural steel shall be fabricated in conformity with dimensions, arrangement, sizes and weights or thicknesses shown on the Drawings or stipulated in the Specifications.

2. All members and parts, as delivered and erected, shall be free of winds, warps, local deformations or unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked, so that proper fit will result when the units are assembled in the field.

F. GALVANIZING

1. All galvanizing shall be done by the hot-dip process, after fabrication in conformity with requirements of ASTM A 123, A 153, A 384 and A 385. Articles to be galvanized shall be pickled before galvanizing.

2. Areas of galvanizing damaged by welding or burning or otherwise damaged shall be thoroughly stripped and cleaned and recoated with zinc to the required thickness by the hot-dip process.

3. Galvanized articles shall be free from uncoated spots, blisters, flux, black spots, dross, projections and other defects not consistent with acceptable galvanizing practice.

4. Zinc and cadmium plating shall be subject to visual examination to determine uniformity of coating. The Engineer may require that the coating uniformity be tested in accordance with ASTM A 239.

PART 3 EXECUTION

3.01 INSTALLATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Structural Aluminum

1. General Except as specifically noted on the Drawings, or specified herein, all materials and work for structural aluminum shall conform with the applicable provisions of the latest edition of “Specifications for Aluminum Structures”, published by the Aluminum Association, Inc., New York, New York.

2. Lay Out: Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material. A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be taken as 0.000013 per degree F.

3. Cutting: Material 1/2-inch thick or less shall be sheared, sawed, or cut with a router. Material more than 1/2-inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Edges or plates carrying calculated stresses shall be planed to a depth of 1/4-inch, except in the case of sawed or routed edges of a quality equivalent to a planed edge. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

4. Heating: Structural material shall not be heated except as provided herein. Material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending. Such heating shall be done only when proper temperature controls and supervision are provided to ensure that the limitations on temperature and time are carefully observed. The Engineer shall be so informed if this method is to be used.

5. Punching, Drilling and Reaming: Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for unfurnished bolts shall be not more than 1/6-inch larger than the nominal bolt diameter. All holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal. All chips lodged between contacting surfaces shall be removed before assembly.

6. Bolting: All bolts for bolting aluminum shall be Type 304 or 316 stainless steel as specified herein.

7. Welding:

   a. Dirt, grease, forming or machining lubricants or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding are required when the inert gas tungsten arc welding method is used. This may be done by etching or scratch brushing. The oxide coating need not be removed if the welding is done with the automatic or semi-automatic inert gas shielding metal arc. Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining or shearing may be used.

   b. Any welding of aluminum shall be done using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used unless prior approval has been obtained from the Engineer. Preheating for welding is permissible provided the temperature does not exceed 400 degrees F for a total time of 30 minutes. Welding of any structure which is to be anodized shall be done using filler alloy rods which will not discolor when anodized.

   c. The welding process and welding operators shall both meet a qualification test conforming to the qualification methods described in the ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.

3.02 PREPARATION

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.

3.03 ERECTION

A. Structural Steel

1. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design."

2. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

    a. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

    b. Weld plate washers to top of base plate.

    c. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do nor remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

    d. Promptly pack grout solidly between bearing surfaces and base or bearing plates so not voids remain. Neatly finish exposed surfaces: protect grout and allow to cure.

3. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

4. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

    a. Level and plumb individual members of structure.

    b. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

5. Splice members only where indicated.

6. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

7. Do not use thermal cutting during erection.

8. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

B. Connections

1. 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.

a. Joint Type: Snug tightened.

2. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

a. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint or surfaces adjacent to field welds.

b. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

c. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.04 PAINTING

A. Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction shall be coated with bitumastic coating.

B. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, the aluminum surfaces shall be kept from direct contact with said metal by the use of neoprene gaskets, 10 mil polyethylene film or insulating washers. Paint or galvanizing will not be considered as adequate protection.

C. Unpainted aluminum surfaces shall be cleaned of all fabrication marking, grease, dirt, and oil. Anodized surfaces shall be cleaned with a mild soap and water solution and no acid, caustic or abrasive cleaning agents shall be used.

D. Structural and miscellaneous metals shall be cleaned, shop primed and painted in accordance with the requirements of Section 09900 of these Specifications.

3.05 INSPECTION AND TESTING

A. Testing Agency: Contractor will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

1. For bolts indicated as "snug tight", inspect to verify that connected elements are in direct contact.

D. Welded Connections:

1. Field welds that fail visual inspection will be tested according to AWS D1.1 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 will not be accepted.

c. Ultrasonic Inspection: ASTM E 164.

d. Radiographic Inspection: ASTM E 94.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 CLEANING

A. Prior to the acceptance of the work under this Section, thoroughly clean all installed materials, equipment, and related areas in accordance with the requirements of Section 01710 of these Specifications.

B. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

C. Touchup Painting Structural Steel: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP3 power-tool cleaning.

2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 05400
COLD-FORMED STEEL STRUCTURAL FRAMING

PART 1 GENERAL

1.01 SCOPE

Furnish and install the cold formed steel structural framing as shown and noted on the Drawings and as specified in this Section, complete.

1.02 REFERENCED PUBLICATIONS

A. The publications listed below form a part of these Specifications.

1. American Iron and Steel Institute (AISI)

Specification for Design of Cold-Formed Steel Structural Members – 2007 Edition with Supplement No. 1.

1.03 DESIGN REQUIREMENTS

A. Where shown on the Drawings, framing shall be fabricated from cold formed steel structural members (CFSSM), galvanized, minimum 18 GA.

B. CFSSM framing shall have out to out dimensions as shown and noted on the Drawings. Unless noted otherwise, intermediate members shown on the Drawings are pictorial only and are not intended to size or locate such members.

C. Design loads: All dead load carried by CFSSM. All live loads as required by the International Building Code 2012 and all design conditions for erection of steel structures, as required by OSHA.

D. Design shall be based on elastic behavior.

E. Roof live loads shall not be reduced to any member.

F Equipment Load: Design each truss for 500# equipment load at any location along truss bottom chord.

1.04 SUBMITTALS

A. Provide for the design of the CFSSM by a structural engineer registered in the State of Georgia, who shall also seal and sign the submittals noted below.

B. Design Certification: Submit to the Engineer certification that the design of the CFSSM for this work is accomplished by the responsible registered structural engineer whose name, seal and signature appears on the certification.

C. Diagrams showing all the load conditions required by the building code noted on the Drawings and all other loads shown, indicated or noted on the Drawings.

These diagrams shall also show all the reactions to the load conditions. The seal and signature of the responsible registered structural engineer shall be applied on these diagram sheets. These diagrams shall be separate from the calculations required for the analysis and design of the structure. Calculations are not required to be submitted to, or reviewed by, the Engineer.

D. A complete set of erection and detail shop drawings, including, but not limited to, anchor bolt sizes and layout, all framing, all openings for vents and louvers. The submittal shall be made in one complete package. The seal and signature of the responsible registered structural engineer shall be applied to these drawings.

E. Certificates of Compliance: Attesting that all materials comply with the requirements of these Specifications.

F. The Engineer will review, comment, and return to the Contractor the required number of marked copies of all items under paragraphs B, C, D, and E. For paragraph D., the Engineer will not comment on erection procedures and does not require their submittal. The Engineer's review and comments for paragraph D. will be for layout and clearances only and will not relieve the Contractor of the responsibility of providing a design and product that meets all the requirements of these Specifications.

G. Products for use on this work shall not be fabricated until all the required submittals have been made, reviewed by, and stamped by the Engineer with the notation "NO EXCEPTIONS TAKEN".

1.05 DELIVERY AND STORAGE

Deliver, store, and handle all building components so that they remain dry and undamaged.

PART 2 PRODUCTS

2.01 FABRICATION

The truss framing shall be shop fabricated and test assembled before shipment to the job site.

2.02 MATERIALS AND CONSTRUCTION

A. All materials shall be completely fabricated and prepared for shipment, including any necessary crating or handling provisions. All parts of the framing are to be accurately made so that in erection all parts will easily fit together. All cutting, punching, and forming shall be performed at the shop. All shop connections shall be bolted. All parts shall be marked and referenced on erection drawings and instructions.

B. Connections
   1. All field connections shall be bolted.
   2. Type and location of anchors shall be included in the Submittal.

PART 3 EXECUTION

3.01 INSTALLATION

A. The added roof framing shall be constructed by a steel erector regularly engaged in the construction of CFSSM. Construct the CFSSM in accordance with the shop/erection drawings and the printed instructions.

B. Keep primary members plumb and stayed in both directions and maintain a safe work place as required by all applicable codes, standards and all applicable OSHA regulations.

C. If defects or errors in fabrication or erection of any building component cannot be corrected in a manner acceptable to the Engineer, remove and provide non-defective components.

D. Field modifications shall not be made unless they are acceptable to the Engineer.

3.02 INSPECTION AND TESTING

A. Provide for inspection of the work by the responsible registered structural engineer and a certification by him, or her, that the framing has been installed according to his/her Drawings and Specifications. As an alternate, the special inspector for the project shall provide such documentation.

B. Provide suitable access to the work for inspection by the Engineer or a testing laboratory of the Engineer's choosing.

END OF SECTION

SECTION 05500
MISCELLANEOUS METALS

PART 1 GENERAL

1.01 SCOPE

The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all miscellaneous metals and related items as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

1.02 SUBMITTALS

A. Make all submittals in accordance with Section 01340 of these Specifications.

B. Shop Drawings

1. Submit shop drawings of all items to be furnished.

2. Shop drawings for steel members shall be as specified in Section 05120 of these Specifications.

3. Submit plan locating embedded connections in masonry and cast-in-place concrete for precast tees. (Precast supplier shall furnish locations unless noted otherwise on the Drawings).

1.03 DIVISION OF WORK

A. General: The following list of items to be furnished under this Section is placed here to aid the various trades in estimating their portion of the Work. It is not a full and complete list and does not relieve the Contractor from providing a totally complete Project including all miscellaneous items.

B. Miscellaneous Metal Items

1. Loose angle and wide flange lintels.

2. Stairs and landings including posts, bearing plates, and integral support beams.

3. Beams, angles and other supporting grating over pipe trenches including embedded connections.

4. Embedded connections and plates in masonry and cast-in-place concrete for precast plank and tees.

5. Bumper posts and sleeves.

6. Bearing plates for other items specified herein.

7. Railings.

8. Edge angles cast-in-concrete.

1.04 QUALITY ASSURANCE

A. Qualifications: For fabrication and erection of the work of this Section, use only personnel completely trained and experienced in the type of work being performed and thoroughly familiar with the original design and the approved shop drawings.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with applicable standards for materials design and construction of the following:

1. American Society for Testing Materials

2. American Institute of Steel Construction

3. American Iron and Steel Institutes "Specifications for the Design of Light Gage Cold Formed Steel Structural Members"

4. Occupational Safety and Health Act

5. American Welding Society

6. National Association of Architectural Metal Manufacturers

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Materials shall be new, top quality of their respective kinds, standard sizes and fabricated in a shop whose principal business is manufacturing the items specified in this Section. Materials shall be free of defect impairing strength, durability, or appearance. Miscellaneous anchors, plates, clips, bolts, nuts, and the like shall be provided as necessary to complete the work, whether or not they appear on the Drawings or in the Specifications.

B. Steel shall conform to ASTM A 36.

C. Cast iron shall be soft, gray iron, true to pattern, smooth and straight, free from defects impairing strength, durability, or appearance.

D. Malleable iron shall be high grade white iron castings, fulling annealed and of uniform ductile structure throughout.

E. Use genuine wrought iron conforming to ASTM A 41 for bolts, rods, and bars; ASTM A 42 for plates, and ASTM A 162 for sheets.

F. Aluminum alloys shall be of uniform quality and free from injurious defects and meet the properties and applicable specifications of the Aluminum Company of America.

G. Stair Treads: Provide safety treads on all interior and exterior stairs and landings.

1. Acceptable Manufacturers

a. Specified Manufacturer: Wooster Products, Inc.

b. Acceptable Manufacturers: American Safety Tread Company, Inc,. or American Abrasive Metals Company.

2. General

a. Treads shall have extruded aluminum arrow base, heat treated for increased strength.

b. Treads shall be anchored into concrete by strap anchors double riveted to the aluminum base or by a continuous "arrow" anchor extruded as an integral part of the tread base. Strap anchors shall be located at the end of each section of tread and on maximum 12-inch centers between.

c. Treads shall have heavy duty factory applied protective tape applied to all finished surfaces.

3. Treads at Concrete Landings at the Top of Metal Stairs

a. Treads shall have a 1 x 1-inch nosing, be 6-inches wide, and the top of the tread shall align even with the top of the landing.

b. Treads shall be Type 104.

4. Treads at all Other Concrete Landings and Concrete Stairs

a. Treads shall be 1/4-inch thick, 6-inches wide and shall incorporate nosing 1/4-inch underside.

b. Dovetail slots 3/16-inch deep shall be filled with a black abrasive consisting of a blend of aluminum oxide and carborundum.

c. Treads shall be Type 161.

5. Coat all aluminum surfaces to be cast into concrete with a bitumastic coating. Set treads level, straight and flush with finished floor surface. Extend treads to within 3-inches of each end of stair tread. Miter all

corners where nosing turns. Do not remove protective tape until all construction and cleanup is complete.

H. Manhole Steps: Steps shall be fabricated of plastic. Steps shall be 10-inches deep x 10-inches wide, 5-inch tread depths, 1 x 1-inch tread section with 2-inch rail height, and shall be reinforced with 3/8-inch steel rods.

I. Interior Trench Grating: Trench grating shall be light-duty grating equal to Neenah R-4468. Angle frame with integral cast anchor lugs shall be equal to Neenah R-4899.

J. Exterior Trench Grating: Grating shall be heavy-duty grating equal to Neenah R-4525 F. Angle frame with integral cast anchor lugs shall be equal to Neenah R-4899.

K. Bird screen shall be No. 2 mesh, brass or copper wire cloth, minimum wire diameter 0.063-inch.

L. All other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds and as selected by the Contractor subject to approval of the Engineer.

2.02 FABRICATION

A. General

1. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

2. Temporary Bracing: Make provision for erection stresses by temporary bracing; keep work in alignment.

3. Welding: Welding shall be continuous along entire area of contact. Welding shall be in accordance with "Code for Welding in Building Construction" of the American Welding Society. Grind exposed welds smooth and flush with adjacent finished surfaces.

4. Painting: Prime paint metal fabrications in accordance with Section 09900 of these Specifications.

5. Items fabricated from structural steel members which are to be architecturally exposed shall be given special attention for material selection with respect to rolling tolerances, surface finish and straightness.

6. Normal structural steel fabrication tolerances will not be acceptable where in conflict with the intent and requirements of this Section.

7. Straightness tolerance, additive to deflection, shall not exceed +1/16-inch to 10 feet.

8. All cope, mitre, and butt caps on exposed surfaces shall be made to the closest possible tolerances consistent with metal shop equipment and practice in order to provide a pleasing appearance.

9. Galvanizing: Items specified to be hot-dip galvanized shall be coated after fabrication.

10. Fastenings shall be concealed where practicable. Thickness or metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water. Provide holes and connections for the work of other trades.

B. Aluminum Stairs

1. Unless noted otherwise, all stairs shall be of the grating type. The top surfaces of all bearing bars shall be striated to provide a non-slip surface and the leading edges of all treads and landings shall receive a 1-inch abrasive aluminum nosing. Components shall be of aluminum alloy 6063-T6 or 6063-T5.

2. Design and fabrication shall be provided by the supplier in accordance with the Drawings. Minimum design live load is 100 pounds per square foot and a concentrated live load of 300 pounds per square foot. Recommended standards of NAAMM and AISC shall be followed. Refer to the Drawings for stairs and landings receiving brick or tile pavers.

C. Aluminum Ladder: Meet OSHA requirements.

PART 3 EXECUTION

3.01 GENERAL

A. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

B. Coordination: Supply to appropriate trades, items requiring to be cast into concrete, embedded in masonry, complete with necessary setting templates.

C. Touch-Up: After installation, touch-up field welds and scratched and damaged surfaces.

D. Protection: Where required, provide approved protection against galvanic action between contacts of dissimilar metals or situations that will cause deterioration of metals in contact or associated in any way.

3.02 PAINTING

Painting shall be in accordance with Section 09900 of these Specifications.

3.03 CLEANING

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

SECTION 05501
ANCHOR BOLTS

PART 1 GENERAL

1.01 SCOPE

A. Adhesive anchor bolts shall be provided for mechanical equipment where indicated on the Drawings or as required by equipment manufacturer's anchor bolt setting plan.

B. Expansion bolts shall be provided where indicated on the Drawings and as required to attach anchor ladders, handrails, stairs, ship's ladders, and structural steel shapes to hardened concrete or masonry.

C. Embedded anchor bolts shall be provided where indicated on the Drawings or in the Specifications or where recommended by equipment manufacturers.

1.02 MATERIAL STORAGE

All material shall be stored in manner which will protect it from deterioration and damage.

PART 2 PRODUCTS

2.01 ADHESIVE ANCHOR BOLTS

A. Adhesive anchor bolts shall consist of a stainless steel threaded rod meeting the requirements of ASTM F 593 (AISI 304). Installation shall be in conformance with the manufacturer's instructions and under the supervision of a manufacturer's field representative for maximum pullout and shear strength.

B. All nuts shall be of stainless steel meeting requirements of ASTM F 594 Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Adhesive anchor bolts shall be Epcon System Ceramic 6 Epoxy Adhesive by ITW Ramset/Red Head or HIT HY 150 Injection Adhesive by Hilti Fastening Systems.

2.02 EXPANSION ANCHOR BOLTS

A. Expansion anchor bolts shall be stainless steel, AISI Type 304 or 316 and shall be of the wedge or self-drilling type. Expansion anchors shall conform to the applicable requirements of Federal Specifications FF-S-325. Installation methods shall be in conformance with the manufacturer's recommendations for maximum pullout and shear strength, but in no case shall the depth of the hole be less than five bolt diameters. The minimum distance between the center of

the expansion anchor and an edge or exterior corner shall not be less than 6 times the diameter of the hole in which it is installed.

B. All nuts shall be of stainless-steel meeting requirements of ASTM F 594 Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Expansion anchors shall be "Trubolt" by ITW Ramset/Red Head, or "KWIKBOLT II" by Hilti Fastening Systems.

2.03 EMBEDDED ANCHOR BOLTS

A. Embedded anchor bolts, except those used for equipment anchoring, shall be carbon steel unless stainless steel is required on the Drawings or Specifications. Embedded anchor bolts used for anchoring equipment shall be stainless steel.

B. Carbon steel anchor bolts shall meet the requirements of ASTM A 307 or ASTM A 193, Grade B8. Bolts shall be threaded per ANSI B1.1.

C. Stainless steel anchor bolts shall meet the requirements of ASTM A 276, Type 304.

D. All nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern. Nuts for carbon steel bolts shall meet the requirements of ASTM A 194, Grade 8. Nuts for stainless steel bolts shall meet the requirements of ASTM A 276, Type 304.

E. All washers shall conform to ANSI B27.2 and shall be 18-8 stainless steel.

PART 3 EXECUTION

3.01 ADHESIVE ANCHOR BOLT INSTALLATION

A. Drilled Holes: Holes for adhesive anchors shall be drilled with a rotary percussion hammer drill with a carbide tipped masonry drill bit conforming to ANSI B94.12-77. Hole diameter and depth shall be as specified by the manufacturer.

B. Hole Cleaning and Preparation: After drilling, dust and fragments shall be cleared out using a water jet, circular wire brush and compressed air. The hole may be damp but all water must be blown out.

C. Curing: Anchor shall be unloaded and allowed to cure for manufacturer's recommended curing time.

3.02 EXPANSION BOLT INSTALLATION

A. Drill expansion bolt holes into concrete through item being supported or locate by a template. Drill all holes by a tool designed by or approved by manufacturer of expansion anchors.

B. Installation of expansion anchors shall be in compliance with manufacturer's recommendations for maximum holding power, but in no case shall depth of hole be less than four bolt diameters. Minimum distance between center of any expansion anchor and an edge or exterior corner of concrete shall be not less than 4-1/2 times diameter of hole in which it is installed.

3.03 EMBEDDED ANCHOR BOLT INSTALLATION

Anchor bolts shall be properly located and built into connecting work. Bolts shall be preset by the use of templates or such other methods as may be required to locate the anchor bolts accurately. All base plate anchor bolt nuts shall be turned down tight.

END OF SECTION

SECTION 05511
METAL STAIRS

PART 1- GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Preassembled steel stairs with concrete-filled treads.

2. Handrails and railings attached to metal stairs.

3. Handrails attached to walls adjacent to metal stairs.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal stairs capable of withstanding the following structural loads without exceeding the allowance design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component of metal stairs.

1. Treads and Platforms of Metal Stairs: Capable of withstanding a uniform load of 100 lbf/sq. ft. or a concentrated load of 300 lbf on an area of 4 sq. in., whichever produces the greater stress.

2. Stair Framing: Capable of withstanding stresses resulting from loads specified above in addition to stresses resulting from railing system loads.

3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

4. Handrails and Railings: Railings shall be capable of resisting a force of 50 lbf applied in any direction at the top and to transfer this load safely to the supports of the structure. Handrail assemblies shall also be capable of resisting a single concentrated load of 200 lbs. applied in any direction at any point along the top and to safely transfer this load to the supports of the structure. Intermediate railings shall be designed to withstand a horizontally applied normal load of 50 lb. On an area not to exceed 1 foot square.

1.03 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal stairs. Include plans, elevations, sections, and details of metal stairs and their connections.

Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Arrange for metal stairs specified in this Section to be fabricated and installed by the same firm.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal stairs (including handrails and railing systems) that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.05 COORDINATION

Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2- PRODUCTS

2.01 FERROUS METALS

A. Metal Surfaces, General: Provide metal free from pitting, seam marks, roller marks, and other imperfections where exposed to view on finished units. Do not use steel sheet with variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.

B. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

E. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.

F. Uncoated, Hot-Rolled Steel Sheet: Commercial quality, complying with ASTM A 569; or structural quality, complying with ASTM A 570, Grade 30, unless another grade is required by design loads.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications using E70 xx, low-hydrogen electrodes.

2.02 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Machine Screws: ASME B18.6.3.

D. Lag Bolts: ASME B18.2.1.

E. Plain Washers: Round, carbon steel, ASME B18.22.1.

F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.03 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field- applied topcoats despite prolonged exposure.

2.04 GROUT

Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.05 CONCRETE FILL AND REINFORCING MATERIALS

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 3000 psi.

B. Deformed Reinforcing Steel: ASTM A 615, Grade 60. Coordinate with Section 03300, “Cast-In-Place Concrete”.

2.06 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, handrails, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

B. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

C. NAAMM Stair Standard: Comply with “Recommended Voluntary Minimum Standards for Fixed Metal Stairs” in NAAMM AMP 510, “Metal Stairs Manual”, for class of stair designated, unless more stringent requirements are indicated.

1. Service class, unless otherwise indicated.

D. Shop Assembly: Preassemble stairs in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

E. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Shear and punch metals cleanly and accurately. Remove sharp or rough areas on exposed surfaces.

F. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Weld exposed corners and seams continuously, unless otherwise indicated.

5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.07 STEEL-FRAMED STAIRS

A. Stair Framing: Fabricate stringers of structural-steel channels, plates, or a combination of both, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural-steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; bolt or weld framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

B. Metal Risers, Subtread Pans and Subplatforms: Form to configurations shown from steel sheet of thickness necessary to support indicated loads, but not less than 0.0677 inch.

1. Steel Sheet: Uncoated hot-rolled steel sheet, unless otherwise indicated.

2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.

3. Shape metal pans to include nosing integral with riser.

4. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.

5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.08 STEEL TUBE HANDRAILS AND RAILINGS

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Interconnect members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.

1. At tee and cross intersections, cope ends of intersecting members to fit contour of tube to which end is joined, and weld all around.

C. Form changes in direction of handrails and rails as follows:

1. By flush-radius bends.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of handrail and railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting railings and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

I. For nongalvanized handrails and railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.09 FINISHES

A. Comply with NAAMM'S "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed products:

1. Interiors (SSPC Zone 1A): SSPC SP 3, "Power Tool Cleaning."

D. Apply shop primer to prepared surfaces of metal stair components, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3- EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.02 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or

shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 INSTALLING STEEL TUBE RAILINGS AND HANDRAILS

A. Adjust handrails and railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.

B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. Use type of bracket with predrilled hole for exposed bolt anchorage.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

SECTION 05524
COMPONENT ALUMINUM HANDRAIL AND LADDERS

PART 1- GENERAL

1.01 SCOPE

A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install component aluminum handrail and ladders, including all fittings, anchors, sleeves, and accessories, as shown on the Drawings, and specified herein.

B. Unless specifically designated on the Drawings, all handrails and ladders shall be a component system meeting the requirements of this section of the Specifications.

C. Handrails and ladders shall be furnished and installed where shown on the Drawings.

D. Handrails shall be furnished with a toe board, except on the railings for stairs or where concrete curbs a minimum of 4-inches high are provided.

1.02 DESIGN REQUIREMENTS

A. Component aluminum handrail and ladder system, including railings, posts, rungs, and gates, shall be designed, and constructed in strict compliance with the requirements of OSHA, the International Building Code and ANSI.

B. Component aluminum handrail system shall also be designed:

1. To withstand the working loads below with a minimum factor of safety of 1.5 based on the ultimate strength of the alloy used.

2. For a minimum safe working load of both of the following loads:

a. 50 pounds per linear foot applied horizontally to the top rail and a vertical load of 100 pounds per foot applied simultaneously.

b. A 200 pound concentrated load applied in any direction at any point on the railing.

C. Component ladder system shall also be designed as follows:

1. Ladder rungs shall be designed to withstand a concentrated load of 250 pounds plus 30 percent impact. Maximum rung deflection shall not exceed L/360. The design load shall be applied at the center of the rung on a 4-inch-wide area.

2. Ladder side rails shall be designed to withstand a minimum live load of two 250-pound loads plus 30 percent impact concentrated between any two consecutive attachments.

D. Splice joints shall be designed and constructed to provide strength equivalent to a straight section of pipe.

1.03 SUBMITTALS

A. Submit complete shop drawings and product data in accordance with the requirements of Section 01340 of these Specifications.

B. Submit, in accordance with the requirements of Section 01730 of these Specifications, manufacturer's recommendations and procedures for maintaining and repairing handrail, including methods, cleaning materials, refinishing materials and precautions as to the use of materials which may be detrimental to handrail finish.

C. Submit certifications as required in Article 1.05 below.

1.04 STORAGE AND PROTECTION

A. Keep handling to a minimum and maintain protective covering on handrail until the work is complete. The Contractor shall take care in handling the rails during shipment, unloading, erection, and during construction to prevent damage to the railing.

B. Railing and post components shall be individually wrapped in paper or plastic film sleeves to protect the finish during shipment and installation and shall not be covered with any protective paper or other covering which can adhere to, or damage, the components.

1.05 QUALITY ASSURANCE

A. The Contractor shall provide the Engineer with written certification that the aluminum handrail, ladders, and accessories are designed and manufactured in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the aluminum handrail and ladder supplier may be considered evidence of compliance, provided such tests are performed in accordance with the appropriate ASTM testing standards by experienced, competent personnel. Tests for ladders shall show that design loads have been applied and released a minimum of 200,000 times to demonstrate fatigue resistance and a safe extended service life. Deflection shall be checked periodically and shall not exceed L/360 at any time under full design load. At completion of testing, the rung and attachments to the side rail shall be inspected for cracks, looseness, distortion, bending (permanent set) or other obvious damage. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on certified sample of handrail stock.

B. Furnish a manufacturer's inspection certificate stating that the handrail and ladder system as installed meets the requirements of these Specifications and the Manufacturer's written instructions. Contractor shall correct all inadequacies found during the inspection process.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Component aluminum handrail and ladder system shall be “Tuf Rail” as manufactured by Thompson Fabricating Company of Birmingham, Alabama, or “AlumaRail” as manufactured by Alumagard of Denver, Colorado, “Interna-Rail” as manufactured by Hollaender Manufacturing Co. of Cincinnati, Ohio and “Wes Rail II” as manufactured by Moultrie Manufacturing Company of Moultrie, Georgia.

2.02 MATERIALS AND CONSTRUCTION

A. Railing: Handrail railing and ladder side rails shall be an extruded tube manufactured from an aluminum alloy in accordance with ASTM B 221, Alloy 6105, Temper T5 or Alloy 6063, Temper T6. Railing shall have a minimum outside diameter of 1.90- inches. Railings shall have a minimum wall thickness of 0.145-inch.

B. Handrail Posts

1. Posts shall be an extruded tube manufactured from an aluminum alloy in accordance with ASTM B 221, Alloy 6105, Temper T5. Posts shall have a minimum outside diameter of 1.90-inches. Posts shall have a minimum wall thickness of 0.20-inch.

2. The posts shall have an internal reinforcing dowel to assist in the transfer of the loadings from the post to the base. The dowel length shall extend 12-inches (or longer if required by the manufacturer to meet criteria) above the walking surface and recessed 1/4-inch from bottom of post and shall be tack welded in two locations to secure dowel in the post.

C. Ladder Rungs: Rungs shall be designed to provide a non-slip power grip surface with a flat 1-inch wide serrated top surface and a semi-circular bottom. The straight sides and semicircular bottom shall have striations at approximately 5/16-inch centers for gripping surface. The rung shall be an aluminum extrusion, Alloy 6063-T6, of sufficient section modulus and moment of inertia to withstand the design loads. Finish shall be mill finish.

D. Adhesive Anchor Bolts: Adhesive anchor bolts shall be designed with a safety factor of 4 on ultimate withdrawal and shear in 4,000 psi concrete. Adhesive bolts shall be spaced a minimum of 10d apart with 5d minimum edge distance without reduction of withdrawal and shear values used in calculations. Adhesive bolts shall be stainless steel.

E. Fasteners: Handrail and ladder system shall be assembled using components that make rigid joints. Railing joints shall be assembled using stainless steel set screws. Other joints shall be assembled using stainless steel fasteners. No pop riveted, glued systems, or welded railing will be allowed.

F. Anodizing: Unless noted otherwise, all railing and posts, and their components, shall be clear anodized on all exposed surfaces conforming to AAM12C22A41 (Class I), 0.7 mil.

G. Brackets and Bases

1. Side mount brackets shall be non-welded extrusions attached to posts with stainless steel set screws.

2. Top mounted bases shall be al-mag castings, anodized. Castings shall be permanent mold or die cast. If bases are sand castings or machined, they shall be finished smooth prior to anodizing to approximate the finish of permanent molds or diecast satisfactory to the Engineer. Castings shall be attached to the post with stainless steel set screws and pressure plate. Cast bases shall slip over the outside of the pipe post so that the pipe and integral internal dowel may function together in transferring the load to the base flange. Aluminum bases of welded construction are not acceptable.

H. Handrail system shall provide for draining of entrapped water from the railing systems by minimum 15/64-inch diameter weep holes or other approved means.

I. Toeboards: Toeboards shall be of the same material and finish as the rails and posts. Toeboards shall be extruded design that clamp to the post to allow expansion and contraction. Toeboards shall have a minimum height of 4-inches.

J. Gates: Gates shall be of the same material and finish as the rails and posts. Gates shall be equipped with a spring to assist in closing.

K. Fall Prevention: Where the floor-to-floor vertical distance exceeds eight feet, provide a fall prevention system as follows:

1. Manufacturer: ‘SAF-T-CLIMB” fall Prevention System as manufactured by North Safety Products, Brea, California, (800) 421-3841.

2. Construction: System components shall be made of 6061-T6 aluminum alloy with a mill finish.

3. SAF-T-PIVOT Dismount Section: At the top of all ladders which do not terminate at a floor door or roof scuttle, such as one at a mezzanine or tank, install an 8-foot long SAF-T-PIVOT dismount section. The top of the dismount section shall be 4 ½-feet above the floor at the top of the ladder and shall have a removable stainless-steel pin which, when removed, will allow the sleeve to slip off the top. The pin shall be configured to firmly stay engaged to the dismount section and shall have an attached stainless steel ring attached to one end of a stainless steel

chain. The other end of the chain shall be attached to the bolt at the top of the guide rail. Install two additional rung clamps on the top two or three ladder rungs for additional support as recommended by the manufacturer.

4. Eyebolts: At the top of all ladders which terminate at roof scuttles or floor doors, furnish and install a stainless steel closed eyebolt in the center of each top ladder rail bracket. The eyebolt shall be made of 3/8-inch diameter steel, shall have an inside opening width of 2 ¼-inches, shall be oriented vertically, and shall have all the excess threaded portion removed and ground smooth.

5. Harness Sets: Provide one harness set in each of the five available sizes, total five sets, each of which shall be comprised of a Saf-T-Harness No. 730-201- XXX, a Saf-T-Lanyard No. 732-201-071, and a Saf-T-Lok Sleeve No. 602-100-01. Also provide five heavy duty aluminum hooks equal to Ives Model 405- A14. Hooks shall be installed at a location within the Project as directed by the Engineer and in a manner to support a vertical load of 50 pounds without noticeable deflection. Harness Sets are available from: North Safety Products, 26 Dansk Court, Toronto, Ontario M9W5V8, Tel: (800) 836-8006. Hooks are available from any Finish Hardware supplier.

PART 3- EXECUTION

3.01 INSTALLATION

A. General: Handrail and ladder system shall be assembled and installed in strict compliance with the manufacturer's instructions. Maximum post spacing shall be 6'- 0". The handrail manufacturer may use less than 6'-0" if their system requires closer spacing to meet design criteria.

B. Shop Assembly: Handrail manufacturer shall shop assemble the handrail and ladders in shippable modules not to exceed 30 feet in length. Field manufacturing of handrail and ladder modules will not be permitted.

C. Set handrail modules plumb within 1/8-inch of vertical and align horizontally to within 1/8-inch in 12 feet. Set stair rail modules plumb within 1/8-inch of vertical and set rake rails aligned horizontally to 1/8-inch in 12 feet. Set ladder modules plumb within 1/8- inch of vertical.

D. Handrail mounting shall be embedded, top mounting base, or side mounted as shown on the Drawings. Install expansion bolts to proper depth to develop full withdrawal and shear values. Check all fasteners and bolts in base connections and splices for tightness.

E. Handrail and ladder components coming into contact with concrete or dissimilar metals shall be coated with bituminous protective coating or installed with a vinyl isolation gasket.

F. Splice joints to facilitate removal of pipe railing shall be provided at all intersections, changes in direction or at intervals not to exceed 30 feet in straight runs of railing.

G. Adequate provisions for expansion and contraction shall be incorporated in the rails. Expansion joints shall be placed at 60 foot intervals. Handrail shall not be continuous across concrete expansions joints.

H. Open rail ends shall be closed by terminal end fittings.

I. Unless noted otherwise, gates shall be provided in all handrail and ladder openings. Chains will not be permitted at handrail and ladder openings.

J. Toeboards shall be shipped loose and field assembled to posts with clamps. The attaching system shall be such that contraction and expansion can occur while maintaining a straight line. Toeboards shall be set so that the bottom of the toeboard is within 1/4-inch above the walking surface.

K. All defective, damaged, or otherwise improperly installed handrail, ladders, gates, and fall prevention systems shall be removed and replaced with material that satisfies the requirements of this Section.

3.02 CLEANING

Following installation, aluminum handrail, ladders, gates and fall prevention systems shall be cleaned using soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used. If stains remain after cleaning, remove finish, and restore in accordance with the manufacturer's written instructions to the satisfaction of the Engineer.

END OF SECTION

SECTION 05530
ALUMINUM GRATINGS

PART 1- GENERAL

1.01 SCOPE

A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install all aluminum gratings and stairway treads, including all supporting angles, anchors and incidental fastenings where shown on the Drawings or specified herein.

B. Unless specifically designated otherwise on the Drawings, all gratings and treads shall be aluminum.

1.02 DESIGN REQUIREMENTS

Aluminum grating shall be designed for an extreme fiber stress in bending of not more than 10,000 psi and a deflection of not more than 1/300 of the span length or 0.25-inch, whichever is smaller, under a uniform live load of 100 pounds per square foot. The depth and thickness of the main bearing bars shall not be less than that shown on the Drawings (1-inch minimum) and the clear spacing between main bearing bars shall not exceed 1-1/8-inches.

1.03 SUBMITTALS

Complete shop drawings and engineering data shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

1.04 STORAGE AND PROTECTION

Aluminum gratings shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

1.05 QUALITY ASSURANCE

The Contractor shall provide the Engineer with written certification that the aluminum grating and treads are in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the grating or stair tread supplier may be considered evidence with the appropriate ASTM testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on certified samples of aluminum bar stock. Cost for this testing to be borne by Contractor.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Grating shall be IKG, Seidelhuber, Liskey or Ohio Grating.

2.02 Aluminum Gratings

A. Aluminum gratings shall be fabricated of I-shaped or rectangular 6061-T6 or 6063-T6 aluminum alloy bars welded or pressure locked together into rigid panels. Grating and banding bars shall be machine cut. Top surfaces of main bearing bars shall be grooved or serrated to provide a non-slip surface.

B. Grating panels shall be simply supported by shelf angles on two sides of the openings and shall be reversible. The gratings shall be of the type that can be made in panels of the widths and lengths appropriate to the openings shown on the Drawings, no gratings will be accepted which require individual panels to be made up by binding narrow panels together with end or intermediate binding strips welded thereto. The ends of all grating panels and the edges of all openings shall be provided with banding strips of the same depth and thickness of the main bars, welded thereto and neatly finished at the intersections with the bars. After installation, there shall not be more than 1/4-inch clearance between sides of adjacent panels. Panels shall be furnished in sizes that weight does not exceed 80 pounds.

C. The top surface of all bars shall be flush and all gratings shall lie flat with no tendency to rock when installed. Cross bars and edge bars of adjacent panels shall align for neatness. Maximum spacing between adjacent panels shall not exceed 1/4-inch. All main bearing bars shall be parallel. Cross bars shall be cut off flush with outside face of side bars.

D. Grating panels shall be securely anchored in place with stainless steel "J" bolts or aluminum saddle or hook clamps. Galvanized hardware shall not be acceptable. A minimum of two fasteners over each support shall be provided.

E. Main bearing bars shall be supported by aluminum shelf angles of the size and thickness as shown on the Drawings. There shall not be more than 1/4-inch clearance between the ends of the grating panels and the inside vertical face of the shelf angle.

F. Grating panels shall be within 3/16-inch, plus or minus of authorized length and width, and shall have a maximum difference in length of opposite diagonals of 3/16-inch. Spacing of bearing bars shall be within 1/32-inch of authorized spacing.

G. All surfaces shall be sound, smooth, clean, and free from defects. Completed sections shall be level and true so as to rest firmly on the bearing angles along the entire contact surface. Openings, where required, shall be neatly and accurately made to the dimensions required as shown on the Drawings. Poorly fitted or damaged grating shall be replaced. All angular, circular, or reentrant cuts shall be made by sawing or shearing. Flame cutting will not be permitted.

H. Unless otherwise shown, openings to be covered with grating shall be bound on all four sides with a continuous shelf angle frame having welded corners and sufficient strap anchors for anchorage into the concrete.

I. Where changes in channel direction, openings for gates, ends of grating runs, etc., prohibits adequate support for grating, additional cross angles shall be furnished to provide a seating surface.

J. Grating shall be laid out so that openings in the gratings are centered on a joint between adjacent panels. Where joints occur normal to the direction of span, they shall be centered on structural support with not more than 1/8-inch between ends of adjoining panels.

K. Solid plank grating shall be I-bar reinforcing designed to meet the deflection requirements specified herein. The solid plank shall have a non-slip surface.

PART 3- EXECUTION

3.01 INSTALLATION

A. Gratings shall be installed in accordance with the manufacturer's recommendations and instruction.

B. Gratings shall have no tendency to shift, rock or rattle and shall not exhibit excessive deflection under normal foot traffic.

C. Stair treads shall be installed at the proper spacing and alignment and shall be level. Stairs shall not sway or vibrate under ordinary foot traffic. Additional bracing or supports shall be provided, if necessary.

3.02 SURFACE PREPARATION AND SHOP PAINTING

A. Surface preparation and shop painting shall be in accordance with the requirements of Section 09900 of these Specifications.

B. Aluminum surfaces to be embedded in concrete or otherwise placed in contact with masonry construction shall be given a heavy shop coat of a zinc chromate primer in accordance with Federal Specification TT-P-645. The paint shall be applied as received from the manufacturer without the addition of any thinner.

C. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, the aluminum surfaces shall be kept from direct contact with said metal by the use of neoprene gaskets, 10 mil polyethylene film or insulating washers. Paint or galvanizing will not be considered as adequate protection.

3.03 FIELD PAINTING

Field painting shall be in accordance with the requirements of Section 09900 of these Specifications.

3.04 CLEANING

Prior to the acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

SECTION 05532
ALUMINUM PLATFORMS

PART 1 - GENERAL

1.01 SCOPE

Provide the structural design of and furnish and install the platforms as shown and indicated on the Drawings. Member sizes shown on these Drawings are minimum requirements.

1.02 DESIGN REQUIREMENTS

A. Code: International Building Code, 2000, Edition.

B. Design Loads

1. Grating for platform, 150 psf.

2. Beams supporting grating, 150 psf for each square foot of contributing area in addition to the dead load of the structure, all piping (empty or filled with water) and dead load plus live load of all equipment shown on the Drawings.

3. All seismic and wind loads required by the referenced code.

C. Design shall be based on elastic behavior. Deflections on walkway beams shall be limited to L/300. Lateral deflection shall be limited to H/500.

D. Compression flanges of walkway beams shall be stabilized by suitable struts and/or bracing. The use of the grating to support compression flanges is prohibited.

E. The design, fabrication, and erection of each of the components furnished under this Section of the Specifications shall meet the applicable requirements of Section 05120, Structural Metals.

F. Handrails shall meet the requirements of Section 05524, Component Aluminum Handrails.

G. Aluminum gratings shall meet the requirements of Section 05530, Aluminum Gratings.

H. Design shall be in accordance with the Aluminum Association, Inc. Specifications.

I. Field connections shall be bolted.

1.03 SUBMITTALS

A. Provide for the design of the aluminum platforms, and walkways by a structural engineer registered in the state in which this Project is located who shall seal and sign the submittals noted below.

B. Design Certification: Submit to the Engineer certification that the design of the aluminum platforms, and walkways for this work is accomplished by the responsible registered structural engineer whose name, seal and signature appears on the certification.

C. Diagrams showing all the load conditions required by the building code noted and all other loads shown, indicated, or noted on the Drawings and as specified in this Section of these Specifications. These diagrams shall also show all the reactions to the load conditions. The seal and signature of the responsible registered structural engineer shall be applied on these diagram sheets. Calculations are not required to be submitted to, or reviewed by, the Engineer.

D. A complete set of erection and detail shop drawings, including, but not limited to, anchor bolt sizes and layout, all framing, and connections. The submittal shall be made in one complete package. The seal and signature of the responsible registered structural engineer shall be applied to these drawings.

E. Certificates of Compliance: Attesting that all materials comply with the requirements of these Specifications.

F. The Engineer will review, comment, and return to the Contractor the required number of marked copies of all items under paragraphs B, C, D and E. For paragraph D., the Engineer will not comment on erection procedures and does not require their submittal. The Engineer's review and comments for paragraph D. will be for layout and clearances only and will not relieve the Contractor of the responsibility of providing a design and product that meets all the requirements of these Specifications.

PART 2- PRODUCTS

2.01 MATERIALS

A. All products shall be new and undamaged.

B. Framing members and grating shall conform to the Aluminum Association, Inc. (AAI) Specification 6061-T6.

C. Connection bolts and anchor bolts shall conform to AISI Type 316 stainless steel.

D. Base plates shall conform to AAI 6061-T6 or AISI Type 304 stainless steel.

E. Shop welding shall conform to AAI 6066-T6.

PART 3- EXECUTION

3.01 INSTALLATION

Fabrication and installation shall be in accordance with Section 05120, Structural Metals.

END OF SECTION

SECTION 06001
CARPENTRY

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Lumber to have visible grade stamp, of an agency certified by the NFPA, The Southern Pine Association, The West Coast Lumberman's Association, American Plywood Association or other recognized lumber producing associations.

B. Treated lumber shall be pressure treated with wood preservative. Cellar Wolmanized or Osmose K 33 lumber.

C. Plywood: Each panel of softwood plywood shall bear the grade trade mark of the American Plywood Association and shall meet requirements of Product Standard PS 1. Hardwood shall conform to requirements of Commercial Standard CS 35.

D. Non sub grade, defective or machine marked pieces shall be installed.

E. Perform finish carpentry work in accordance with recommendations of the Millwork Standards of the Architectural Woodwork Institute.

1.02 PRODUCT DELIVERY AND HANDLING AND STORAGE

A. Protect sheet material from having corners broken and surfaces damaged while handling.

B. Immediately upon delivery to job site, place materials in area protected from the weather at least 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.

C. Protect seasoned materials against high humidity and moisture during storage and erection.

1.03 REFERENCES

A. Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program: Architectural Woodwork Institute.

B. National Forest Products Association National Design Specification for Stress Grade Lumber and Its Fastening.

C. Southern Pine Use Guide: Southern Forest Products Association.

D. Manual for House Framing: National Lumber Manufacturers Association.

E. Wood Structural Design Data 1978: Batuibak forest Products.

F. Product Use Manual: Western Wood Products Association.

G. Plywood Specification and Grade Guide: American Plywood Association.

H. Standard Building Code: Southern Building Code Congress International, Inc.

PART 2 PRODUCTS

2.01 Lumber for rough carpentry shall be kiln dried and well seasoned with moisture content not to exceed 15% and shall be graded by the producing association.

2.02 Treated lumber shall be pressure treated with wood preservative for all lumber in contact with masonry or concrete and other locations indicated on the drawings. Cellar, Wolmanized, or Osmose K 33 lumber is approved.

2.03 FRAMING

A. Top plates, rafters and joists shall be No. 2 Southern Yellow Pine.

B. Miscellaneous framing shall be spruce, cedar or Southern Yellow Pine, grades as listed above.

2.04 WOOD TRUSS RAFTERS

A. GENERAL

1. Truss rafters shall be of shape, span and spacing shown on the drawings.

2. Wood truss rafters shall be prefabricated by a company with a minimum of five years experience in the manufacturing of successful truss rafters.

3. Truss rafters shall be fabricated by a company approved by the connector plates manufacturer and in accordance with the plate manufacturer's standard method and specifications.

4. Submit complete shop drawings, design calculations, stress analysis, and joint analysis all bearing the seal of a professional engineer licensed to practice in the State of Georgia for approval.

B. MATERIAL

1. Connector plates shall be light metal plate connectors conforming to requirements of T.P.I. specifications of either the nailed type of nailess press in type.

2. Lumber for truss rafters shall be as specified below and be so stamped on each and every piece.

a. TOP CHORDS: SYP #2 KD MG
b. BOT CHORDS: SYP #2 KD MG
c. WEB MEMBERS: SYP #2 KD
d. OTHER: SYP #2 KD

3. Truss rafters shall be designed to carry loads for structure as shown with minimum loads on top chords and bottom chords as shown on drawings and deflecting under designed loads shall not exceed 1/360 of span.

C. FABRICATORS

1. Trusses shall be designed, fabricated and connected to support applied dead loads and all wind and live loads required by the Standard Code, Current Edition. They shall be shop assembled so that wood members have full bearing, particularly at the peak and head joints.

2. Wood members must be firmly held in position in suitable jigs until the teeth or nails are embedded in the wood. Nailless teeth plates shall be pressed into place by a hydraulic clamp or by the double pass roller method.

2.05 LUMBER FOR FINISH CARPENTRY

A. Moisture content of finish softwood lumber shall not exceed 6% for interior work and 10% for exterior.

B. Moisture content of finish hardwood lumber shall not exceed 6%.

C. Fascia and other wood trim shall be fir.

2.06 PLYWOOD

A. Soffits: 3/8" thick, A C fir exterior plywood.

2.07 PLYWOOD SIDING

B. Shall be APA 303 Siding Ext. premium grade, pine; reverse board and batten design, rough sawn 5/8" thick, grooves at 12" o.c.

PART 3 EXECUTION

3.01 FRAMING AND BLOCKING

A. Refer to drawings for framing sizes, space and detail.

B. Framing for locations not detailed shall be provided with supporting members in general 2" thick, depth shown and spaced not over 16" o.c. No. 2 Southern Yellow Pine or Douglas Fir, unless noted otherwise.

C. Framing shall be cut and fitted, true to line and level, avoiding shims and wedges.

D. Bolt wood members to concrete and masonry round, bolts, spaced 3' 0" o.c. and within 4" of each end of plates at splices and corners.

E. Provide blocking, bucks and framing for other trades.

3.02 FINISH HARDWARE

A. Installation:

1. Install and make adjustments for correct working order.

2. Any hardware damaged by improper adjustment or abuse will be replaced by the contractor at his expense.

3. Fit all surface applied hardware.

4. Provide clean, sized and place mortises and drilled holes for all mortise hardware such as locksets, flush bolts and pivots.

5. After hardware installation, protect exposed sur¬faces from wear and abuse by the use of heavy paper and masking tape and maintain until job completion.

6. Center kick plates at bottom of doors and provide same margin at bottom as at sides.

B. Removal for Painting: Remove all hardware, except that which is primed for painting before painter's finish is applied and replace and readjust for function after painter's finish has been completed and has dried hard.

3.03 Plywood siding shall be nailed at 6" o.c. along perimeter of the panel and at 12" o.c. at intermediate supports with 8d hot dipped galvanized common nails. All edges of panels must have solid backing.

3.04 Install metal trim and flashing as indicated on the drawings.

3.05 Each item specified in this section shall be installed plumb, rigid, square and level with all moving parts working.

3.06 Ensure all mechanical and electrical items affecting the Section of Work are properly placed and complete prior to commencement of installation.

3.07 Hand Doors.

3.08 Install hardware fixtures and accessories supplied under other Sections for installation. Install in strict accordance with manufacturer's recommendations.

3.09 CLEANING

A. After completion of Finish Carpentry work, clean all surfaces remove all debris and leave spaces broom clean. Examine all doors and other moving parts, adjust as required.

END OF SECTION

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Framing with dimension lumber.

2. Framing with engineered wood products.

3. Wood furring, grounds, nailers, and blocking. Sheathing.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 6 Section "Metal-Plate-Connected Wood Trusses."

1.03 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise specified.

B. Exposed Framing: Dimension lumber not concealed by other construction and indicated to receive a stained or natural finish.

1.04 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.

B. Product Data for the following products:

1. Engineered wood products.

2. Air-infiltration barriers.

3. Metal framing anchors.

4. Construction adhesives.

C. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.

1. Engineered wood products.

2. Air-infiltration barriers.

3. Metal framing anchors.

4. Power-driven fasteners.

5. Fire-retardant-treated wood.

D. DELIVERY, STORAGE, AND HANDLING

1. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

2. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

a. <u>Wood-Preservative-Treated Materials:</u>
Baxter: J. H. Baxter Co.
Chemical Specialties, Inc.
Continental Wood Preservers, Inc.
Hickson Corp.
Hoover Treated Wood Products, Inc.
Osmose Wood Preserving, Inc.

c. <u>Fire-Retardant-Treated Materials, Interior Type A:</u>
Baxter: J. H. Baxter Co.
Chemical Specialties, Inc.
Continental Wood Preservers, Inc.
Hickson Corp.
Hoover Treated Wood Products, Inc.

d. Fire-Retardant-Treated Materials, Exterior Type:
American Wood Treaters, Inc.
Hoover Treated Wood Products, Inc.

e. Laminated-Veneer Lumber:
Alpine Structures.
Boise Cascade Corp.
Georgia-Pacific Corp.
Louisiana-Pacific Corp.
Trus Joist MacMillan.
Willamette Industries, Inc.

f. Parallel-Strand Lumber:
Alpine Structures.
Trus Joist MacMillan.

g. Air-Infiltration Barriers:
Amoco Foam Products Co.
Anthony Industries, Inc.; Simplex Products Division.
Celotex Corporation (The); Building Products Division.
DuPont Company; Fibers Department.
Parsec, Inc.
Raven Industries, Inc. Reemay, Inc.
Sto-Cote Products, Inc.

h. Metal Framing Anchors:
Simpson Strong-Tie Company, Inc.

2.02 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

E. Provide dressed lumber, S4S, unless otherwise indicated.

F. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

B. Do not use chemicals containing chromium or arsenic.

C. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m). After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

D. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

E. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

F. Wood framing members less than 18 inches (460 mm) above grade.

G. Wood floor plates installed over concrete slabs directly in contact with earth.

H. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m).

I. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.04 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

B. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

C. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

D. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.

E. No form of degradation occurs due to acid hydrolysis or other causes related to treatment. Contact with treated wood does not promote corrosion of metal fasteners.

F. Exterior Type: Use for exterior locations and where indicated.

G. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

2.05 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.

B. Non-Load-Bearing Interior Partitions. Provide framing of the following grade and species:

Grade: Construction, Stud, or No. 3.
Species: Mixed southern pine; SPIB.
Species: Spruce-pine-fir south; WCLIB or WWPA.

D. Exterior and Load-Bearing Walls. Provide framing of the following grade and species:

Grade: Construction or No. 2.
Species: Spruce-pine-fir south; NELMA.
Species: Southern pine; SPIB.

F. Other Framing Not Listed Above: Provide the following grades and species:

Grade: Construction, Stud, or No. 3.
Species: Southern pine; SPIB.

2.06 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.07 ENGINEERED WOOD PRODUCTS

A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that evidence compliance with building code in effect for Project.

B. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated on drawings. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Wall Sheathing: APA-rated Structural I sheathing.

D. Exposure Durability Classification: Exposure 1.

E. Span Rating: As required to suit stud spacing indicated.

F. Roof Sheathing: APA-rated Structural I sheathing.

G. Exposure Durability Classification: Exposure 1.

H. Span Rating: As required to suit rafter spacing indicated.

2.08 STRUCTURAL-USE PANELS FOR BACKING

A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant- treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 15/32 inch (11.9 mm) thick.

2.09 AIR-INFILTRATION BARRIER

A. Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.

B. Air retarder complying with ASTM E 1677; made from polyolefins; either cross-laminated films, woven strands, or spunbonded fibers; coated or uncoated; with or without perforations to transmit water vapor but not liquid water; and as follows:

1. Minimum Thickness: 3 mils (0.08 mm).

2. Minimum Water-Vapor Transmission: 10 perms (575 ng/Pa x s x sq. m) when tested according to ASTM E 96, Procedure A.

3. Maximum Flame Spread: 25 per ASTM E 84.

4. Minimum Allowable Exposure Time: 3 months.

2.10 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

B. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

C. Nails, Wire, Brads, and Staples: FS FF-N-105.

D. Power-Driven Fasteners: CABO NER-272.

E. Wood Screws: ASME B18.6.1.

F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M)

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.11 METAL FRAMING ANCHORS

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and as follows

1. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for Project.

2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

3. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

2.12 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturers.

C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2- propynyl butyl carbonate (IPBC) as its active ingredient.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.

2. Published requirements of metal framing anchor manufacturer.

3. "Table 2304.9.1 -- Fastening Schedule," of the International Building Code.

F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

G. Use hot-dip galvanized or stainless-steel nails where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity.

H. Countersink nail heads on exposed carpentry work and fill holes with wood filler.

3.02 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.03 WOOD FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Firestop furred spaces of walls at each floor level and at ceiling with wood blocking or noncombustible materials, accurately fitted to close furred spaces.

C. Furring to Receive Plywood Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring at 24 inches (610 mm) o.c., horizontally and vertically. Select furring with no knots capable of producing bent-over nails and damage to paneling.

D. Furring to Receive Gypsum Board: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring at 16 inches (406 mm) o.c., vertically.

3.04 WOOD FRAMING, GENERAL

A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Install framing members of size and at spacing indicated.

Do not splice structural members between supports.

Firestop concealed spaces of wood-framed walls and partitions at each floor level and at ceiling line of top story. Where firestopping is not inherent in framing system used, provide closely fitted wood blocks of 2-inch nominal- (38-mm actual-) thickness lumber of same width as framing members.

3.05 WALL AND PARTITION FRAMING

A. General: Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction, unless otherwise indicated.

B. For exterior walls, provide wood studs at the size and spacing indicated.

C. For interior partitions and walls, provide 2-by-4-inch nominal- (38-by-89-mm actual-) size wood studs spaced 16 inches (406 mm) o.c., except where otherwise indicated or required.

D. Construct corners and intersections with 3 or more studs. Provide miscellaneous blocking and framing as shown and as required to support facing materials, fixtures, specialty items, and trim.

E. Provide continuous horizontal blocking at midheight of single-story partitions over 96 inches (2438 mm) high and multistory partitions, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.

F. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

G. For non-load-bearing partitions, provide double-jamb studs with headers not less than 4-inch nominal (89-mm actual) depth for openings 36 inches (900 mm) and less in width, and not less than 6-inch nominal (140-mm actual) depth for wider openings.

H. For load-bearing walls, provide double-jamb studs for openings 72 inches (1800 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth shown or, if not shown, as recommended by AFPA's "Manual for Wood Frame Construction."

I. Provide bracing in walls, at locations indicated, full-story height, unless otherwise indicated. Provide one of the following:

J. Performance-rated structural-use panels, not less than 48 by 96 inches (1219 by 2438 mm) applied vertically.

3.06 INSTALLATION OF STRUCTURAL-USE PANELS

A. General: Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

B. Sheathing: Nail to framing.

C. Space panels 1/8 inch (3 mm) at edges and ends.

D. Plywood Backing Panels: Nail or screw to supports.

END OF SECTION

SECTION 06192
METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

a. Triangular-pitched roof trusses.
b. Girder trusses.
c. Truss accessories.

B. Related Sections: The following Sections contain requirements that relate to this Section:

a. Division 5 Section "Metal Fabrications" for rough hardware anchoring trusses to concrete or masonry structures.

b. Division 6 Section "Rough Carpentry" for roof and floor sheathing of structural-use panels and dimension lumber for supplementary framing and permanent bracing.

1.03 DEFINITIONS

Metal-plate-connected wood trusses include planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and erect metal-plate-connected wood trusses to
B. withstand design loads within limits and under conditions required.

C. Design Loads: As indicated.

D. Design trusses to withstand design loads without deflections greater than the following:

E. Roof Trusses: Vertical deflection of 1/180 of span due to total load.

F. Engineering Responsibility: Engage a fabricator who uses a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for metal-plate-connected wood trusses.

1.05 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and
B. Division 1 Specification Sections.

C. Product Data for lumber, metal-plate connectors, metal framing connectors, bolts, and fasteners.

D. Shop Drawings detailing location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber to be used; splice details; type, size, material, finish, design values, and orientation and location of metal connector plates; and bearing details.

    a. To the extent truss design considerations are indicated as fabricator's responsibility, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

    b. Include truss Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

E. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.
    a. Metal-plate connectors.
    b. Metal framing connectors.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed wood truss installation similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator's Qualifications:
Engage a firm that complies with the following requirements for quality control and is experienced in fabricating metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in-service performance:

a. Fabricator participates in a recognized quality-assurance program that involves inspection by SPIB; Timber Products Inspection, Inc.; Truss Plate Institute (TPI); or other independent inspecting and testing agency acceptable to Architect and authorities having jurisdiction.

C. Comply with applicable requirements and recommendations of the following publications:

a. ANSI/TP1 1, "National Design Standard for Metal-Plate-Connected Wood Truss Construction."
b. TPI HIB "Commentary and Recommendations for Handling Installing & Bracing Metal Plate Connected Wood Trusses."
c. TPI DSB "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."

D. Metal-Plate Connector Manufacturer's Qualifications:
A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in ANSI/TPI 1.

E. Single-Source Responsibility for Connector Plates:
Provide metal connector plates from one source and by a single manufacturer.

F. Wood Structural Design Standard:
Comply with applicable requirements of AFPA's "National Design Specification for Wood Construction" and its "Supplement."

G. Professional Engineer Qualifications:
A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated that have resulted in installing metal-plate-connected wood trusses similar to those indicated for this Project and with a record of successful in service performance.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses with care and comply with manufacturer's written instructions and TPI recommendations to avoid damage and lateral bending.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.08 SEQUENCING AND SCHEDULING

Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers:
   a. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      i. Metal Connector Plates:
      Alpine Engineered Products, Inc.
      Computrus, Inc.
      Mitek Industries, Inc.
      Robbins Manufacturing Company.
      Tee-Lok Corporation.
      Truswal Systems Corporation.

      ii. Metal Framing Anchors:
      Simpson Strong-Tie Company, Inc.

2.02 DIMENSION LUMBER

A. Lumber Standards:
   a. Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Grade Stamps:
   a. Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Provide dressed lumber, S4S, manufactured to actual sizes required by DOC PS 20 for moisture content specified, to comply with requirements indicated below:

D. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

E. Grade and Species: Provide dimension lumber of any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specification for Wood Construction" and its "Supplement."

2.03 METAL CONNECTOR PLATES

A. General:
    a. Fabricate connector plates from metal complying with requirements indicated below.

B. Hot-Dip Galvanized Steel Sheet:
    a. Structural-quality steel sheet, zinc coated by hot-dip process complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; Grade 33 and not less than 0.0359 inch (0.91 mm) thick.

2.04 FASTENERS

A. General:
    a. Provide fasteners of size and type indicated that comply with requirements specified below for material and manufacture.
    b. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of stainless steel, Type 304 or 316.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts and Screws: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts:
    a. Steel bolts complying with ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.05 METAL FRAMING ANCHORS

A. General:
   a. Provide metal framing anchors of structural capacity, type, size, metal, and finish indicated that comply with requirements specified, including the following:

   b. Research or Evaluation Reports: Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for this Project.

   c. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized Steel Sheet:
   a. Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 (ASTM A 653M, Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

2.06 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint:
   a. SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.07 FABRICATION

B. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

C. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated.

D. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances of ANSI/TPI 1. Position members to produce design camber indicated.

   Fabricate wood trusses within manufacturing tolerances of ANSI/TPI 1.

E. Connect truss members by metal connector plates located and securely embedded simultaneously into both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Do not install wood trusses until supporting construction is in place and is braced and secured.

B. Before installing, splice trusses delivered to Project site in more than one piece.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to recommendations of TPI and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space, adjust, and align trusses in location before permanently fastening and as follows:
    a. Truss Spacing: As indicated.

G. Anchor trusses securely at all bearing points using metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

    a. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

J. Install wood trusses within installation tolerances of ANSI/TPI 1.

    a. Do not cut or remove truss members.

K. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.

    a. Do not alter trusses in the field.

3.02 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Protective Coating:
    a. Clean and prepare exposed surfaces of embedded-metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.

    b. Apply materials to provide minimum dry film thickness recommended by manufacturer of coating system.

END OF SECTION

SECTION 07150
DAMPPROOFING

PART 1 - GENERAL

1.01 SCOPE

A. The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all dampproofing as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

B. The bituminous dampproofing materials specified herein shall be surface applied as follows:

1. Do not apply to the outside of concrete tanks which contain water.

2. Apply to wall behind exterior wythe as indicated on the Drawings.

C. Provide all labor, materials, equipment, and appliances as required for the proper installation of dampproofing as follows:

1. Prepare all surfaces as specified herein to receive dampproofing.

2. Provide dampproofing at all vertical and horizontal surfaces shown on the Drawings.

3. The manufacturer shall provide all certifications, test data, affidavits or samples requested by the Engineer.

4. Perform all installations to comply with local rules, ordinances and regulations, OSHA Requirements and EPA Statutes complying with environmental protection.

5. Perform all installations in accordance with the approved construction progress schedule or at such times necessary for the orderly and expeditious completion of the Project.

6. Upon completion of dampproofing, remove all waste or rubbish resulting from dampproofing operations and all equipment used for same.

1.02 SUBMITTALS

Submit approved manufacturer's product literature for dampproofing materials including all special details and recommended application procedures in accordance with the requirements of Section 01340 of these Specifications.

1.03 PRODUCT HANDLING

A. Protection: Use all means necessary to protect dampproofing materials before, during and after installation and to protect the installed work and materials of all

other trades, contiguous to the dampproofed surfaces. Packaged containers shall be stored on wood skids, 6-inches off the ground and covered with heavy plastic sheeting which shall remain in place at all times.

B. Replacement: All broken containers and their contents shall be removed from the premises, discarded in a legal fashion, and replaced with new materials at no additional cost to the Owner.

1.04 COORDINATION

A. Review all Drawings and details of installations of other adjoining materials and cooperate with the respective trades.

B. The applicator's particular attention is directed to the requirement to properly prepare surfaces for the attachment of other materials and to chip out and repack surfaces at all attachments.

1.05 QUALITY ASSURANCE

A. Qualifications of Installers

1. The applicators performing this work must have a minimum of five years experience in this type of dampproofing and be able to show that they have successfully carried out contracts of a similar nature, size, and scope.

2. Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly experienced in installation of the specified products and shall direct all work performed under this Section.

B. Manufacturer's Certification: Prior to start of installation of the work of this Section, arrange a visit to the job site by a representative of the manufacturer of the dampproofing materials used, who shall inspect and certify:

1. That the surfaces to which dampproofing is to be applied are in condition suitable to receive dampproofing.

2. That the materials to be installed comply in all respects with the requirements of this Section.

3. That the applicator has the experience to install said materials in complete accordance with the manufacturer's current recommendations.

1.06 WARRANTY

Furnish a written warranty, warranting materials and workmanship for a period of five years after acceptance of the work of this Section and binding the Contractor to repair and make good, at no additional cost to the Owner, all defects which appear during this period.

PART 2- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Cold-applied, asphalt emulsion dampproofing shall be equal to Chem Rex, Inc., Sonneborn, or W.R. Meadows.

2.02 BITUMINOUS DAMPPROOFING

A. General: Provide products recommended by manufacturer for designated application.

B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions. Trowel grade shall be emulsified asphalt mastic, prepared with mineral-colloid emulsifying agents suitable for application in a relatively thick film, complying with ASTM D 1187, Type I.

2.03 PRIMER

Asphalt primer complying with ASTM D 41, for asphalt-based dampproofing.

PART 3- EXECUTION

3.01 INSTALLATION

A. Apply all dampproofing materials in strict accordance with manufacturer's instructions and recommendations and this Section.

B. Before backfilling against dampproofing, repair all damaged surfaces.

3.02 PREPARATION

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.

B. Install accessories as recommended by prime materials manufacturer even through not shown.

C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

D. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

E. Prime substrate as recommended by prime materials manufacturer.

F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.03 INSTALLATION, GENERAL

A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.

B. Application: Apply dampproofing to the following surfaces:

1. Exterior surface of inside wythe of double-wythe, exterior masonry walls above grade, to prevent water-vapor penetration through the wall.

2. Where indicated on the drawings.

3.04 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING

Trowel-Grade: Trowel apply a coat of mastic asphalt emulsion dampproofing onto substrate at a minimum rate of 7 gallons per 100 square feet, to produce an average, dry-film thickness of 60 mils but not less than 30 mils at any point.

3.05 PROTECTION AND CLEANING

Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

END OF SECTION

SECTION 07210
BUILDING INSULATION

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section includes furnishing all labor, materials and equipment required to furnish and install all building insulation as specified herein and/or shown on the Drawings.

1.02 SUBMITTALS

A. Complete product data shall be submitted to the Engineer.

B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values, fire performance and sound abatement characteristics.

1.03 STORAGE AND PROTECTION

Insulation shall be stored indoors in a dry location in accordance with the manufacturer's instructions.

1.04 QUALITY ASSURANCE

A. All insulation shall be delivered to the site in unopened packages. Packages shall be clearly marked with the manufacturer's name, type, quantity of insulation and "R" value (where applicable).

B. Installer Qualifications for Foamed-In-Place Masonry Insulation: Engage an experienced dealer/applicator who has been trained and licensed by the product manufacturer and which has not less than three years direct experience in the installation of the product used.

PART 2 PRODUCTS

2.01 FOAMED-IN-PLACE MASONRY INSULATION

A. Foamed-In-Place Masonry Insulation: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.

1. Fire-Resistance Ratings: Minimum four (4) hour fire resistance wall rating (ASTM E-119) for 8-inch and 12-inch concrete masonry units when used in standard two (2) hour rated CMUs.

2. Surface Burning Characteristics: Maximum flame spread, smoke developed and fuel contributed of 0, 5 and 0 respectively.

3. Combustion Characteristics: Must be noncombustible, Class A building material.

4. Thermal Values: “R” Value of 4.91/inch at 32 degrees F mean; ASTM C-177.

5. Sound Abatement: Minimum Sound Transmission Class (“STC”) rating of 53 and a minimum Outdoor Indoor Transmission Class (“OITC”) rating of 44 for 8- inch wall assembly (ASTM E 90-90).

2.02 BATT INSULATION

Batt insulation shall be nominal 24-inch wide Kraft paper faced fiberglass Batts with a thickness as shown on the Drawings.

2.03 VAPOR BARRIER

Vapor barrier shall be 0.006-inch thick polyethylene film membrane in a width as wide as practical.

PART 3 EXECUTION

3.01 INSTALLATION OF FOAMED-IN-PLACE INSULATION

A. General: Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer’s instructions.

B. Installation: Fill all open cells and voids in hollow concrete masonry walls where shown on Drawings. The foam insulation shall be pressure injected through a series of 5/8-inch to 7/8-inch holes drilled into every vertical column of block cells (every 8 inches on center) beginning at an approximate height of four (4) feet from finished floor level. Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled. Patch holes with mortar and score to resemble existing surface.

3.02 INSTALLATION OF VAPOR BARRIER

Install vapor barrier directly over fill and perimeter insulation. Where joints in membrane occur, lap a minimum of 18-inches. Exercise care not to puncture the membrane. Where punctures occur, patch so as to maintain a continuous membrane. Install concrete slab floor directly over the vapor barrier.

3.03 CLEANING

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas.

END OF SECTION

SECTION 07600
FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment and material required to install all sheet metal work, including metal flashing and counterflashing, flashing transitions, wall flashing, gutters, downspouts, scuppers, copings, and related work as described herein and/or shown on the Drawings.

1.02 SUBMITTALS

A. Submittals shall be made to the owner for approval via ME Sack Engineering.

B. Submit written information regarding material proposed and installation instructions for the use substantiating compliance with Specification requirements. Submit two samples, 8-inches long, of each type of flashing or sheet metal fabrication and each accessory specified.

C. Samples for Verification of each type of exposed finish indicated in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

D. Submit shop drawings, showing manner of forming, jointing and securing flashings, guttering and accessories. Detail waterproof connections to adjoining work and at obstructions and penetrations. Shop drawings shall indicate thickness and dimensions of all parts, fastening and anchoring methods, details and locations of all seams, joints and other provisions necessary for thermal expansion and contraction.

1.03 STORAGE AND PROTECTION

A. Sheet metal materials and accessories shall be stored and protected in accordance with the requirements of these Specifications.

B. The Contractor shall protect all stainless steel materials from exposure to chlorides and muriatic acids. Wash affected areas immediately with five percent soda solution and rinse with clear water.

C. Sheet metal work shall be handled with sufficient care to prevent damage to surfaces, edges and ends. All material at site shall be stored above ground in a covered, dry location. Damaged material that cannot be restored to its original condition will be rejected and shall be replaced at no additional cost to the Owner.

1.04 QUALITY ASSURANCE

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

1.05 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied finish within the specified warranty period and agreeing to repair finish or replace components that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

C. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 METALS

A. Aluminum Extrusions: ASTM B 221, 6063-T5 alloy and temper, or as recommended by the manufacturer for use intended and as required for proper application of finish indicated.

B. Aluminum Sheet: ASTM B 209, alloy and temper as recommended by the aluminum producer and finisher for use intended and finish indicated, with not less than the strength and durability of alloy and temper designated below.

1. Alloy 3003-H14, with a minimum thickness of 0.040-inch, unless otherwise indicated, for aluminum sheet with mill finish.

2. Alloy 5005-H14, with a minimum thickness of 0.050-inch for aluminum sheet with other than mill finish.

C. Galvanized Steel Sheet: ASTM A 653, G90 coating designation; commercial quality; at least 0.034-inch thick, unless otherwise indicated.

D. Stainless Steel Sheet: ASTM A 666, Type 304, soft annealed, with No. 2D finish, unless harder temper is required for forming or performance; at least 0.0187-inch thick, unless otherwise indicated.

2.02 GUTTER AND DOWNSPOUTS

A. Provide gutters and downspouts in shapes and sizes indicated, with mitered and welded corners. Install steel straps formed from at least 0.028-inch thick, galvanized steel sheet; hangers, or other attachment devices; screens; end

plates; and trim and other accessories indicated or required for a complete installation.

B. Provide gutters and downspout components fabricated from formed aluminum sheet in thickness indicated, but not less than the following:

1. Gutter Thickness: 0.050-inch.

2. Downspout Thickness: 0.025-inch.

2.03 COPINGS

Provide copings in shapes and sizes indicated, with shop-fabricated corners. Coping shall be Petersen Aluminum TITE-LOC Coping System UL-I90, fabricated from formed aluminum sheet, not less than 0.050-inch thick. Color as indicated on Drawings.

2.04 PARAPET SCUPPER AND CONDUCTOR HEADS

Provide parapet scuppers and conductor heads as indicated on Drawings. Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch wide wall flanges to interior and base extending 4-inches beyond cant or tapered strip into field of roof. Fabricate conductor heads with flanged back, stiffened top edge, and built-in overflows. Fabricate conductor heads and scuppers from 0.0320 aluminum. Finish to match metal coping.

2.05 ACCESSORIES

A. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.

B. Exposed Fasteners: Stainless steel, non-magnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.

C. Concealed Fasteners: Same metal as item fast or other non-corrosive metal as recommended by the manufacturer.

D. Galvanizing Repair Paint: High-zinc-dust content paint for regalvanizing weld in steel, complying with SSPC-Paint 20.

E. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15 mil dry film thickness per coat.

F. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non- immigrating sealant.

G. Foam-Rubber Seal: Manufacturer's standard foam.

H. Adhesives: Type recommended by the manufacturer for substrate and Project conditions, and formulated to withstand a minimum of 60 pounds per square foot wind up-lift force.

I. Splash Blocks: Splash blocks shall be reinforced precast concrete, 3,000 psi, 30 x 16 x 4-inches thick.

J. Bituminous Plastic Cement: Where bituminous plastic cement is specified or shown on the Drawings, use cement conforming to Federal Specification SS-C-153, Type I.

K. Solder: Solder shall be ASTM B 32, Alloy grade 58, composed of 50 percent tin and 50 percent lead.

L. Flux: Flux used on stainless steel shall be a phosphoric acid base flux equal to "MicroFlex Soldering Flux" by Washington Steel Corporation or Type "MA" by Lake Chemical Co.

2.06 FINISHES - GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective coating before shipment.

C. Finish manufactured roof specialties after fabrication and assembly if products are not fabricated from pre-finished metals.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

2.08 METAL FINISHES

A. General: Apply coating either before or after forming and fabricating flashing and sheet metal as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and

cure by application of strippable film or removable adhesive cover, and retain until installation has been completed.

B. Fluoropolymer Coating: Full-strength, 70 percent “Kynar 500” coating baked-on for 15 minutes at 450 degrees F in a dry film thickness of 1.0 mil, 30 percent reflective gloss (ASTM D 523), over minimum 0.2 mil baked-on modified epoxy primer.

C. Durability: Provide coating which has been field tested under normal range of weathering conditions for a minimum of 20 years without significant peel, blister, flake, ship, crack, or check in finish, and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

D. Color: As selected from manufacturer’s standard colors, and as indicated on the Drawings.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that substrates are smooth and clean to extent needed for sheet metal work.

B. Verify that reglets, nails, cants and blocking to receive sheet metal are installed and free of concrete and soil.

C. Do not start sheet metal work until conditions are satisfactory.

3.02 PREPARATION

A. Before installing sheet metal, verify shapes and dimensions of surface to be covered.

B. Promptly remove protective film, if any, from exposed surfaces of finished metals. Strip with care to avoid damage to finish.

C. Prepare concrete, concrete masonry block, cement plaster, and similar surfaces to receive roof edge system specified. Install blocking, cleats, water dams, and other anchoring and attachment accessories and devices required.

3.03 INSTALLATION

A. General

1. Install all flashing and sheet metal work in accordance with the "Architectural Sheet Metal Manual" by SMACNA.

2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.

3. Hem exposed edges except edges forming drip lips.

B. Seams

1. Common Lock Seams: 5/8-inch finished width; four-ply loose lock.

2. Flat Lock Seams: 3/4-inch finished width; four-ply flat lock, malleted tight; sweated full with solder.

3. Drive Lock Seams: Fold back abutting edges; cover joint with 1/8-inch wide loose drive cap.

4. Single Corner Seams: 5/8-inch finished width; three-ply loose lock; corners lapped and soldered.

5. Double Corner Seams: 5/8-inch finished width; four-ply double lock

6. Lap Seams: 7/8-inch finished width.

7. Soldered Lap Seams: 1-inch finished width; sweated full with solder.

C. Gutters

1. Install inside straps at 30-inches on center, riveted to rear of gutter and locked into beaded front edge.

2. Support lower edge of gutter with heavy duty support brackets at 30-inches on center. Alternate with inside straps.

D. Downspouts

1. Hangers shall conform with SMACNA, minimum 0.028 x 1-inch flat stock galvanized steel.

2. Downspout shall be securely fastened to the wall with aluminum bands located not more than five feet apart. Anchorage shall be made with 1/4-inch stainless steel machine bolts into noncorrosion anchors.

E. Conductor Heads and Scuppers: Conform design and installation with SMACNA.

F. Soldering

1. Other Materials: Clean and flux metals prior to soldering. Sweat solder completely through seam width.

3.04 PAINTING

All exposed galvanized items shall be factory-painted in accordance with the requirements of Section 09900 of these Specifications. After installation, the galvanized items shall be touched up with identical paint supplied from the factory.

3.05 INSPECTION

Damaged work shall be repaired or replaced. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or alterations required to ensure a satisfactory installation.

3.06 CLEANING

A. As work progresses, neutralize excess flux with 5 to 10 percent washing soda solution, and thoroughly rinse.

B. Prior to acceptance of the work of this Section, clean all installed materials and affected work areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

SECTION 07610
METAL ROOF PANELS

PART 1 GENERAL

1.01 SUMMARY

This Section includes factory-formed and field-assembled, metal roof panels.

1.02 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

B. Solar Flux: Direct and diffuse radiation from the sun received at ground level over the solar spectrum, expressed in watts per square meter.

C. Solar Reflectance: Fraction of solar flux reflected by a surface, expressed as a percent or within the range of 0.00 and 1.00.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FGM 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FGM markings.

1. Fire/Windstorm Classification: Class 1 A-120.

C. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.04 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profile, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1- 1/2 inches per 12 inches (1:10):

a. Flashing and trim.

C. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Installer's responsibilities include fabricating and installing metal roof panel assemblies and providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of data for metal roof panels, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Engineer, except with Engineer's approval. If modifications are proposed, submit comprehensive explanatory data to Engineer for review.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufacturer items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

C. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field- trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.08 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified elsewhere.

B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: One year from date of Final Acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturer: Subject to compliance with requirements, provide products by the manufacturer specified.

2.02 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the soil-coating process to comply with ASTM A 775/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.

2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.

3. Surface: Smooth, flat finish.

4. Exposed Finishes: Apply the following coil coating, as specified, or indicated on Drawings.

5. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.

3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.03 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type I (No. 15) asphalt-saturated organic felts.

B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.04 MISCELLANEOUS METAL FRAMING

A. General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

B. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch.

2. Depth: 7/8 inch.

C. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.05 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.

1. Fasteners for Roof Panels: Self-drilling or self-tapping 410 stainless or zinc- alloy steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal roof panels.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 METAL ROOF PANELS

A. General: Provide factory-formed metal roof panel assembly designed to be field assembled by covering vertical side edges of adjacent panels with a continuous interlocking leg and mechanically attaching panels to supports using concealed clips.

B. Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Manufacturer: Berridge Manufacturing Company.

2. Panel System: Snap-Clad, 24-gauge steel.

3. Clips: One piece.

   a. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

4. Sealant: Factory applied sealant bead.

5. Panel Coverage: 18 inches nominal.

6. Batten Height: 1.75 inches.

7. Uplift Rating: UL 120.

8. Color: As indicated on Drawings.

2.07 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fascia, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.

2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.0179-inch thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fascia, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.08 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by

laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

5. Conceal Fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.

a. Size: As recommended by SMACA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but no less than thickness of metal being secured.

2.09 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

1. Examine metal deck and mailable insulation so that installation is within flatness tolerances required by metal roof panel manufacturer.

2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install flashings and other sheet metal to comply with requirements specified elsewhere.

C. Miscellaneous Framing: Install sub purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

3.03 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment and building-paper slip sheet on roof sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated on Drawings, in shingle fashion to shed water, with lapped joints of not less than two inches.

B. Install flashings to cover underlayment to comply with requirements specified elsewhere.

C. Apply slip sheet over underlayment before installing metal roof panels.

3.04 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.

2. Install panels perpendicular to purlins.

3. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.

4. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.

5. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.

6. Locate and space fastenings in uniform vertical and horizontal alignment.

7. Install ridge and hip caps as metal roof panel work proceeds.

8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

2. Prepare joints and apply sealants to comply with requirements specified elsewhere.

3.05 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each interlocking joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling fastener.

2. Interlock metal roof panel at seams, fully engaged to provide weathertight joints.

3.06 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual". Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of ten feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than one inch deep, filled with mastic sealant (concealed within joints).

C. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.07 ERECTION TOLERANCES

Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8- inch offset of adjoining faces and of alignment of matching profiles.

3.08 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07900
SEALANTS

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment and material required to apply all sealants and related work as described herein and/or shown on the Drawings.

1.02 SUBMITTALS

Complete engineering and product data shall be submitted to ME Sack Engineering in accordance with the requirements of these Specifications. Color samples shall be submitted for approval by the Owner.

1.03 STORAGE AND DELIVERY

A. Materials shall be stored in strict conformance with the manufacturer's instructions and in accordance with the requirements of these Specifications.

B. Materials shall be delivered to the job site in sealed containers, with the manufacturer's original labels attached and accompanied by written certification indicating compliance with the requirements of these Specifications.

1.04 QUALITY ASSURANCE

The manufacturer shall provide ME Sack Engineering with written certification that all products furnished comply with all applicable requirements of these Specifications.

1.05 WARRANTY

A. Provide a warranty against defective materials and workmanship in accordance with the requirements of these Specifications.

B. The following types of failures will be considered defective work requiring replacement: leakage, hardening, cracking, crumbling, melting, shrinking or running of caulking compound or staining of adjacent work by caulking compound.

PART 2 PRODUCTS

2.01 SILICONE SEALANT

A. Acceptable Products: Dow Corning Corporation (#790), or General Electric Company (Silpruf).

B. Type: One-part low modulus silicone rubber.

C. Colors: To be selected from manufacturer's standard.

2.02 ONE-PART, NON-SAG POLYURETHANE SEALANT

A. Acceptable Products: Mameco International, Vulken (#116), Sonneborn Building Products, Sonolastic (NP-1), or Tremco, Inc. (Dymeric).

B. Colors: To be selected from manufacturer's standard.

2.03 TWO-PART, POURABLE POLYURETHANE SEALANT

A. Acceptable Products: A.C. Horn, Inc. (Daraseal-U), Memeco International, Vulkem (#245), Tremco, Inc. (THC-900), or W.R. Meadows, Inc. (Pourthane).

B. Colors: To be selected from manufacturer's standard.

2.04 ACRYLIC SEALANT

A. Acceptable Products: A.C. Horn, Inc. (Daraseal A.R.), DAP, Inc. (DAP Acrylic), Protective Treatments, Inc. (#737), Tremco, Inc. (Mono), or W.R. Meadows, Inc. (Solaply).

B. Type: One part acrylic polymer sealant.

C. Colors: To be selected from manufacturer's standard.

2.05 JOINT BACKING

Joint backing, where indicated or required, shall be equal to "Tremco Joint Backing" by Tremco Mfg. Company or "Ethafoam SB" backer rod by Dow Chemical Company. Application shall be in accordance with sizes listed below:

Joint Size, inches	Rod Diameter, inches
3/16	1/4
1/4	3/8
3/8	1/2
1/2	5/8
5/8	3/4
3/4	1

2.06 COLORS AN DURABILITY

A. Color of sealant or caulking shall be as selected by ME Sack Engineering.

B. Caulking shall have a minimum life expectancy of 20 years and shall be resistant to the effects of sunlight, abrasion, oils, mild chemicals, cleaning agents and immersion in water.

PART 3 EXECUTION

3.01 PREPARATION

A. All joints or channels shall be cleaned and free of dirt, oil, grease, moisture, old paint, loose mortar, and other foreign matter.

B. Metal surfaces shall be wiped with material equal to Zylol or Mek and then dried.

C. Masonry surfaces shall be cleaned with a wire brush and then blown clean. Any waterproofing treatments contaminating the joint must be completely removed.

D. Where joints are 1/2-inch wide, they should be backed to 1/2-inch of the surface. All 3/4-inch-wide joints shall be backed to 1/4-inch of the surface. Size of joint backing shall be large enough so that it can be compressed by at least 30 percent before inserting into the joint.

E. Surface of concrete or masonry shall be primed in accordance with the manufacturer's printed instructions.

3.02 CAULKING SCHEDULE

A. Silicone Sealant: All exterior joints and interior expansion and control joints, except horizontal floor joints.

B. One-Part, Non-Sag Polyurethane Sealant: Interior joints, except as otherwise scheduled.

C. Two-Part, Pourable Polyurethane Sealant: Horizontal floor and pavement joints.

D. Acrylic Sealant: Interior sealant joints to be painted, except joints in drywall construction of less than 1/8-inch in width.

3.03 APPLICATION

A. The Contractor shall caulk all joints (both inside and outside of jambs, heads, and sills) between the metal doors, windows, louvers, etc. and masonry throughout the buildings, as indicated on the Drawings, or otherwise required, so as to leave the building weathertight.

B. Apply sealant with hand or air gun under sufficient pressure and through nozzle openings of such a diameter so that a full bead of sealant is run into the joint and fills the opening completely.

C. Apply joint backer with a blunt rounded tool in accordance with manufacturer's instructions so it will not stain the sealant.

D. All beads should be tooled immediately after application to insure firm and full contact with the interface of the joint.

E. Work shall be of highest quality and in accordance with the manufacturer's current printed instructions.

3.04 CLEANING

Remove all excess material and smears adjacent to joint as work progresses.

END OF SECTION

SECTION 08100
STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.01 Provide all labor, materials, and services required for complete installation of steel door and frames.

1.02 DELIVERY AND STORAGE

A. To provide protection during shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or provided with temporary steel spreaders at the bottom of each frame; and knockdown type frames shall be securely strapped in bundles.

B. Materials shall be delivered to the site in undamaged condition, stored out of contact with the ground and under a weather tight covering, permitting good air circulation.

C. Whenever they become evident, abraded, scarred or rusty areas shall be cleaned and touched up with the paint used for the shop painting.

1.03 QUALITY ASSURANCE:

Steel doors and frames shall be fabricated in accordance with the applicable standards of:

A. Steel Door Institute (SDI).

B. American National Standards Institute (ANSI).

C. American Society for Testing and Materials (ASTM).

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS FOR FRAMES:

A. Steel: Frames shall be factory fabricated from steel conforming to ASTM A 366 or A 569, stretcher level degree of flatness, pickled and oiled if of hot rolled material, and Manufacturer's Standard Gages specified hereinafter for the various uses.

B. Shop Painting: After fabrication, frames shall be thoroughly cleaned, pretreated to provide a strong bond between metal and paint, and shop painted with a rust inhibiting primer paint.

C. Workmanship:

1. The finish items shall be rigid, neat in appearance, and free from defects warp, or buckle.

2. Welded members shall be sharp in detail, straight, and true.

3. Corner joints shall be coped or mitered, well formed, and in true alignment.

4. Exposed welded joints shall be dressed smooth.

D. Preparation for Hardware:

1. Frames shall be prepared for hardware in conformance with the templates provided under Section 08700, Finish Hardware; the requirements of ANSI A115.1, A115.2, All5.3, A115.4, and A123.1.

2. Cutting, reinforcing, drilling, and tapping of frames shall be done at the factory, except drilling and tapping for surface applied hardware will be done in the field when the hardware is applied.

3. In addition to the plaster guards required for strike reinforcement in the referenced American National Standards, plaster guards shall be provided on the doorframes for the hinge reinforcement.

4. Frames shall be prepared for silencers, and rubber silencers shall be provided with the frames.

E. Sound Deadening:

Doors shall be prepared with a sound deadening material standard with the manufacturer to eliminate metallic sound incident to the normal operation of the door.

2.02 CONSTRUCTION OF FRAMES:

A. Pressed steel frames for doors and other openings shall be of the combination buck, frame, and trim type of the sizes and details shown.

1. Gages of metal shall be not lighter than 16 gauge.

2. Frames shall be welded type.

3. Knockdown frames shall not be permitted.

4. Frames shall have headers and jambs secured at the corners either by internal welding of faces or by welded splice plates and shall be further secured at the rabbet either by welding or by mechanical interlock.

5. As an alternate, the headers and jambs shall be secured at the corners by external welding of faces and grinding smooth.

6. Faces of frames at junction of head and jamb shall present neat line joints. Mullions and transom bars shall member with heads or jambs, as applicable, and shall be butt welded thereto.

B. Anchors:

1. Frames shall be provided with a minimum of 3 wall anchors per jamb spaced not over 24 inches apart as required for the adjoining wall construction, ceiling strut anchors as required for the adjoining wall construction, ceiling strut anchors as required by the drawings, and anchors for attachments of frame to the floor.

2. The bottom of frames shall be at the finish floor level shown and supported by an 18 gauge adjustable or extended clip angle.

3. Jamb anchors shall be of not less than 18 gage steel or 3/16" diameter wire.

2.03 CONSTRUCTION OF DOORS

A. Doors shall be SDI, Grade II, Heavy Duty, the type, size, and design shown.

B. Door clearance shall not exceed the following: 1/8" at jambs and heads; 1/4" at meeting stiles of pair of doors; and 3/4" at bottom measured from finished floor line.

C. Exterior doors shall have top edges closed flush and sealed against water penetration.

D. Flush Doors shall be of full flush construction. Doors shall be internally reinforced to resist impact and to insure flatness of finished surfaces by steel members welded in place, water resistant honeycomb core glued in place or rigid insulation core glued or foamed in place. Doors with metal reinforcing shall have sound deadening material

applied to the interior of the door to eliminate metallic sound incident to normal door operation.

1. Honeycomb core material shall have a crushing strength of not less than 4,000 psf. and the lamination shall with stand not less than 1,500 psf. surface shear.

2. Foam insulation core material shall have a compressive strength of not less than 1,500 psf. and a shear strength not less than 18 psi. shall have an insulation to steel strength at least equal to the strength of the insulation, shall be dimensionally stable within plus or minus 5% of volume after 24 hour exposure to temperature ranging from minus 15 degree F to 165 degree F., shall have no voids exceeding 1/2" in any direction and shall have a density of not less than 1.0 pound per cubic foot. Foam insulation shall be rated as self extinguishing when tested in accordance with ASTM D 1692.

3. Solid mineral insulation core material shall have a density of not less than 20 pounds per cubic foot.

E. Face sheets shall not be less than 18 gage steel, shall have no seams or joints on door faces, and shall have top and bottom closed with a recessed channel or a flush end closure treatment.

F. Doors shall be galvanized.

2.04 APPROVED MANUFACTURERS: Steel craft, Amweld, Fenestra

PART 3 – EXECUTION

3.01 Each item specified in this section shall be installed plumb and level with all moving parts working, complete with all trim, filler panels, and hardware for installation.

3.02 Temporary spreaders shall be installed until the wall at the frame if completed and the frame is securely anchored in its position.

3.03 Wall anchors on door frames shall be installed approximately at the hinge and strike levels.

3.04 Doors shall be installed in conjunction with the application of hardware.

3.05 Weather stripping and thresholds shall be installed at exterior door openings to provide a weather tight installation.

3.06 Finished work shall be strong and rigid, neat in appearance and free from defects. Fabricate molded members straight and true with corner jambs well formed, in true alignment and fastenings concealed where practicable.

END OF SECTIONS

SECTION 08301
FLOOR DOORS

PART 1 GENERAL

1.01 SCOPE

The work covered by this Section consists of furnishing all labor, equipment and materials required to furnish and install aluminum floor doors as shown on the Drawings and/or specified herein.

1.02 DESIGN REQUIREMENTS

Exterior floor doors shall be designed for a live load of not less than 300 pounds per square foot at an extreme fiber stress in bending of not more than 33 percent of the minimum yield strength of the material.

1.03 SUBMITTALS

Complete shop drawings and engineering data shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

1.04 STORAGE AND PROTECTION

Floor doors shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

PART 2 PRODUCTS

2.01 EXTERIOR FLOOR DOORS

A. Exterior floor doors shall be constructed of aluminum with a diamond pattern tread or other acceptable raised non-slip surface. Doors shall be watertight and of the sizes shown on the Drawings.

B. Frames shall be 1/4-inch extruded aluminum formed to a channel gutter approximately 3-inches wide, with an anchor flange around the perimeter. Containing frames shall be neatly made. Sufficient anchors shall be attached to the frames for proper anchoring into the concrete. Clear opening must not be reduced. A 1-1/2-inch drainage coupling for plumber's connection shall be provided in the low corner of the channel frame located as indicated on the Drawings.

C. Doors shall be provided with a minimum of two heavy forged bronze hinges with stainless steel pins. Doors shall be equipped with an outside flush lifting handle, hold back safety chains, spring operators for easy operation and an automatic hold-open arm with vinyl grip release handle.

D. Factory finish for exterior floor doors shall be mill finish with bituminous coating applied to all surfaces in contact with concrete.

E. Floor doors shall be furnished with all stainless steel hardware.

F. Exterior floor doors shall be single-leaf or double-leaf as shown on the Drawings and shall be Bilco Type J or JD.

PART 3 EXECUTION

3.01 INSTALLATION

A. All floor doors shall be completely assembled in the containing frames prior to their delivery to the Project. The exterior of the frames and anchors, or those portions coming in contact with the concrete shall be painted with a heavy coating of asphalt or other bituminous material prior to their installation.

B. All sidewalk door frames shall be installed so they will project slightly above the elevation of the surrounding concrete. No door shall be at an elevation lower than the adjacent concrete construction. They shall present a uniform, level surface with no indentations or projections. All hinged sidewalk doors shall operate freely and without binding.

C. Gutters shall be connected to plant drain piping as shown on the Drawings.

END OF SECTION

SECTION 08330
OVERHEAD ROLLING SERVICE DOOR (HEAVY DUTY)

PART 1 GENERAL

1.01 SCOPE

The Work under this Section consists of furnishing all labor, materials, equipment and services necessary for the complete and satisfactory installation of manually operated overhead heavy duty rolling service door.

1.02 DEFINITIONS

A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide overhead rolling service doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Load: Uniform pressure (velocity pressure) of 30lbf/sq. ft., acting inward and outward.

2. Impact Test for Flying Debris: Comply with ASTM E 1996, tested according to ASTM E 1886.

a. Level of Protection: Basic Protection.

b. Wind Zone: 110 mph, pressure test to ½ and 1-1/2 x design pressure (positive and negative).

B. Operation-Cycle Requirements: Provide overhead rolling service door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

1.04 SUBMITTALS

A. Provide all submittals to ME Sack Engineering.

B. Product Data: Manufacturer's printed product data indicating characteristics of products specified in this Section.

1. For each type and size of overhead rolling service door and accessory. Include summary of forces and loads on walls and jambs.

C. Samples for Initial Selection: At contractor's option provide manufacturer's color charts showing full range of colors available for units with factory-applied finishes for selection by ME Sack Engineering or prime finish and field paint in accordance with Division 9 painting requirements.

D. Shop Drawings:

1. Elevations: Dimensioned elevation of each type of door opening assembly in project, indicate sizes and locations of door hardware, lites and louvers, if specified.

2. For special components and installations not dimensioned or detailed in manufacturer's product data.

3. Details: Installation details of each type installation condition in Work, indicate installation details of glazing, if specified.

D. Manufacturer's Instructions: Printed installation instructions for door opening assemblies.

E. Warranty Documents: Manufacturer's standard warranty of documents, executed by manufacturer's representative, countersigned by the Contractor.

F. Qualification Data: For Installer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required in this Project.

B. Source Limitations: Obtain overhead rolling service doors through one source from a single manufacturer.

1. Obtain operators and controls from overhead rolling service door manufacturer.

1.06 WARRANTY

Manufacturer's Warranty: Manufacturer's 10-year warranty against failure due to corrosion from specified environment.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, manufacturers of products that may be incorporated into the Work include but are not limited to, the following:

1. Alpine Overhead Doors, Inc.
2. Cookson Company
3. Cornell Iron Works Inc.
4. Overhead Door Corp.
5. Raynor
6. Wayne Dalton Corp.

2.02 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: fabricate overhead rolling service door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A, G90 (Z275) coating designation.

a. Minimum Base-Metal (Uncoated) Thickness 0.0209 inch.

2. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying wit maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.

3. Inside Curtain Slat Face: To match material of outside metal curtain slat.

B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1- 1/2 by 1/8 inch (38 by 38 by 3 mm) thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.

1. Astragal: Provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; for placement between angles or fitted to shape, as a cushion bumper for interior door.

D. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.03 HOODS AND ACCESSORIES

A. Hood: Form to act as weatherseal and entirely enclose rolled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.

1. Fabricate hoods for steel doors of minimum 0.028-inch thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

2. Shape: Round or Square.

B. Weatherseals: provide replaceable, adjustable, continuous, compressible weather- stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch thick, replaceable continuous sheet secured to inside of hood.

1. In addition, provide replaceable, adjustable, continuous, flexible, 1/8 inch thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weather tight installation.

C. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jambs for weather tight installation.

D. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.

1. Locking Bars: Single-jamb side operable from inside only.

2. Lock cylinder is specified in Division 8 Section " Door Hardware".

E. Chain Lock Keeper: Suitable for padlock.

2.04 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.

D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load,

E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.05 MANUAL DOOR OPERATORS

A. Provide manual chain-hoist or manual or manual push up operators based on performance requirements listed below and manufacturer's standard offerings.

B. Push-up Operation: Design counterbalance mechanism so required lift or pull for door operation does not exceed 25 lbf.

C. Chain-Hoist Operator: Provide manual chain-hoist operator consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 35-lbf. Force for door operation. Provide alloy steel hand chain with chain holder secured to operator guide.

2.06 FINISHES GENERAL

A. General: Comply with NAAMM's "Metal Finishes manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 STEEL AND GALVANIZED STEEL FINISHES

A. Factory primer for Field Finish: Manufacturer's standard primer, compatible with field- applied finish according to coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

1. Apply to ferrous surfaces except zinc-coated metal.

B. Powder-Coat Finish: Manufacturer's standard powder-coat finish consisting of primer and topcoat according to coating, manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.

1. Color and Gloss: As selected by ME Sack Engineering from manufacturer's full range.

C. At contractor's option provide either a primer finish with field applied finish or Manufacturer's standard finish.

PART 3 EXECUTION

3.01 GENERAL

A. Verification of conditions:

1. Openings are correctly prepared to received doors and frames.
2. Openings are correct size and depth in accordance with shop drawings.

B. Installer's Examination:

1. Have installer examine conditions under which construction activities of this section are to be performed and submit written report if conditions are unacceptable.

2. Transmit two copies of installer's report to architect within 24 hours of receipt.

3. Beginning construction activities of this section before acceptable conditions have been corrected is prohibited.

3.02 INSTALLATION

A. Install rolling service doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

B. Field alteration of doors to accommodate field conditions is strictly prohibited.

C. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.

3.03 ADJUSTING

A. Lubricate bearings and sliding parts: adjust doors to operate easily, free of warp, twist, or distortion and with weather tight fit around entire perimeter.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rolling service doors.

3.05 CLEANING

Clean surfaces of door opening assemblies and sight exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.06 PROTECTION OF INSTALLED PRODUCTS

Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

SECTION 08342
FIBERGLASS REINFORCED PLASTIC DOORS
AND FIBERGLASS RESIN TRANSFER MOLDED DOOR FRAMES

PART 1 GENERAL

1.01 SCOPE

The Work under this Section consists of furnishing all labor, materials, equipment, and services necessary for the complete and satisfactory installation of fiberglass reinforced plastic doors and fiberglass resin transfer molded door frames.

1.02 SUBMITTALS

A. Provide all submittals to ME Sack Engineering.

B. Product Data: Manufacturer's printed product data indicating characteristics of products specified in this Section.

C. Shop Drawings:

1. Elevations: Dimensioned elevation of each type of door opening assembly in project, indicate sizes and locations of door hardware, lites and louvers, if specified.

2. Details: Installation details of each type installation condition in project, indicate installation details of glazing, if specified.

3. Schedule: Indicate each door opening assembly in project, cross-reference to plans, elevations, and details.

D. Manufacturer's Instructions: Printed installation instructions for door opening assemblies.

E. Warranty Documents: Manufacturer's standard warranty of documents, executed by manufacturer's representative, countersigned by the Contractor.

1.03 QUALITY ASSURANCE

Manufacturer Qualifications: Manufacturer: Minimum twenty (20) years documented experience producing products specified in this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, Handling, and Unloading:

1. Deliver single doors, up to 4' x 8', and frames factory-assembled and pre-hung, with hardware. Double doors shipped knocked down.

2. Package door opening assemblies in wood crates having wood perimeters, label crates with the following information:

a. Manufacturer's name

b. Architect/Engineer-designated Project Number

c. Tag location in accordance with door schedule

d. Door type, color, and weight

B. Acceptance at Site: Accept only sealed, crated, and labeled door opening assemblies at site.

C. Storage and Protection: Store door assemblies in factory packaging in dry area, store on edge and protect from damage.

1.05 WARRANTY

Manufacturer's Warranty: Manufacturer's 10-year warranty against failure due to corrosion from specified environment.

PART 2 PRODUCTS

2.01 MATERIALS

A. All material used and consumed by Chem-Pruf in the manufacture of our products are of the highest quality to assure the end product meets Chem-Pruf's specifications.

B. Fiberglass Mat: Random glass fiber mat, minimum 4.5 ounces per square foot weight of glass material.

C. Polyurethane Foam: Minimum density 4 pounds per cubic foot, maximum flame spread 25 in accordance with ASTM E 84.

D. Roving: Unidirectional glass fiber mat, minimum 16 ounces per square yard weight.

E. Resins: Formulated for specified environment, maximum flame spread 25 in accordance with ASTM E 84, self-extinguishing in accordance with ASTM D 635.

F. Anchors: Manufacturer's standard stainless steel anchors.

G. Bonding Materials: Manufacturer's standard frame-to-opening bonding system.

H. Glazing: Type specified in Section 08800, factory installed, if requested.

I. Joint Sealer: Silicone sealant.

2.02 MANUFACTURED UNITS

A. Fiberglass Reinforced Plastic (FRP) doors:

1. Thickness 1-¾-inches

2. Thermal Insulating Value: 'R' factor 12

3. Construction:

a. Site and Rail Structure: One-piece molded U-shaped cross-section, minimum 15 mil gel coat, minimum three (3) layers random-fiberglass mat, saturated with resins.

b. Core: Polyurethane foam.

c. Face sheets: Minimum 15 mil gel coat, with minimum two (2) layers random-fiberglass mat and on (1) layer roving, saturated with resins.

4. Sizes: Indicated on the drawings.

5. Finish: Semi-Gloss Surface.

6. Color: shall be submitted to the owner (via ME Sack Engineering) for approval.

B. Fiberglass RTM Door Frames:

1. Construction: One-piece molded cross-section with molded stop, minimum 15 mil gel coat, minimum two (2) layers random-fiberglass mat, saturated with resins.

2. Sizes: For door sizes and frame depths indicated on the Drawings.

3. Finish: Smooth semi-gloss surface

4. Color: shall be submitted to the owner (via ME Sack Engineering) for approval.

C. Fiberglass RTM Door Windows:

1. Construction: RTM molded solid window frame with profile that drains away from glazing. 15-mil gel coat, minimum two (2) layers random fiberglass mat saturated with resin. Frame is molded into doorplate during door fabrication and becomes an integral part of the door. Glazing held in place by RTM retainer that matches opposite frame profile.

2. Sizes: Indicated on the Drawings.

3. Finish: Match fiberglass door finish.

D. Door Hardware:

1. Specified Section 08710.

2. Due to the special nature of the material in this section, all related hardware as specified must be furnished and installed by the door and frame manufacturer.

2.03 FABRICATION

A. Fiberglass Reinforced Plastic (FRP) Doors: All Chem-Pruf's workmanship is to be of the highest quality in order to meet Chem-Pruf's quality control requirements.

1. Stile and Rail Structure:

a. Form in mold of exact door size, with gel coat layer to form, glass mat layers to a U-shaped channel interior.

b. Formulate gel coat for environment and integral color specified.

c. Form structure as single component, jointed construction at intersections of stiles and rails is prohibited.

d. Form mortise for lockset, and recess for strike plate in lock stile, at time of molding.

e. Embed compression members at the time of molding in locations where thru bolting of hardware is required.

2. Core:

a. Foam polyurethane in place within stile/rail structure, allow no voids within structure.

b. Mold openings for lites or louvers, if specified, form mold to sizes and locations indicated.

3. Face Sheets:

a. Formulate gel coat with integral color specified, embed glass materials.

b. Chemically bond face sheets to stile/rail structure and core material.

B. Fiberglass RTM door Frames

1. Resin transfer in mold of exact wall opening size, with gel coat. Glass mat layers to form solid fiberglass outer surface.

2. Formulate gel coat for environment and integral color specified.

3. Form structure of fiberglass components.

4. Form mortise for lock strike, and recess for strike plate in lock jamb, at time of molding.

5. Embed reinforcement for hinges and other indicated hardware in fiberglass matrix, provide for hinge leaf recesses in hinge jamb at time of molding.

C. Fiberglass RTM Door Windows

1. Form in mold of exact window frame size with 15-mil gel coat, minimum two (2) layers random fiberglass mat. Saturate mat with resin by RTM. Retainer fabricated in same way.

2. Formulate gel coat for environment and color specified.

3. Laminate frame onto exterior doorplate as plate is fabricated to make window frame an integral part of doorplate.

4. FRP retainer held in place with silicone caulk factory applied.

5. Fabricate retainer as a replaceable part so glazing may be replaced in field.

D. Assemble doors and frames with louvers and transoms, if specified, install specified hardware, using through bolts or sex screw with compression members to resist screw torque and to prevent compressing door construction.

PART 3 EXECUTION

3.01 GENERAL

A. Verification of conditions:

1. Openings are correctly prepared to received doors and frames.

2. Openings are correct size and depth in accordance with shop drawings.

B. Installer's Examination:

1. Have installer examine conditions under which construction activities of this section are to be performed and submit written report if conditions are unacceptable.

2. Transmit two copies of installer's report to architect within 24 hours of receipt.

3. Beginning construction activities of this section before acceptable conditions have been corrected is prohibited.

C. Verify that door glazing has been factory-installed, if requested.

3.02 INSTALLATION

A. Install door-opening assemblies in accordance with shop drawings and manufacturer's printed installation instructions, using installation methods and materials specified in installation instructions.

B. Field alteration of doors or frames to accommodate field conditions is strictly prohibited.

C. Site tolerances: Maintain plumb and level tolerance specified in manufacturer's printed installation instructions.

3.03 ADJUSTING

A. Adjust doors in accordance with door manufacturer's maintenance instructions to swing open and shut without binding and to remain in place at any angle without being moved by gravitational influence.

B. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.

3.04 CLEANING

Clean surfaces of door opening assemblies and sight exposed door hardware in accordance with respective manufacturer's maintenance instructions.

3.05 PROTECTION OF INSTALLED PRODUCTS

Protect door opening assemblies and door hardware from damage by subsequent construction activities until final inspection.

END OF SECTION

SECTION 08710
DOOR HARDWARE

PART 1 GENERAL

1.01 SCOPE

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. This Section includes the following:

1. Hinges
2. Lock cylinders and keys
3. Lock and latch sets
4. Bolts
5. Closures
6. Overhead holders
7. Door trim units
8. Weatherstripping for exterior doors
9. Astragals or meeting seals on pairs of doors
10. Thresholds
11. Panic exit device

1.02 REFERENCES

A. Standards of the following as referenced:

1. American National Standards Institute (ANSI)
2. Door and Hardware Institute (DHI)
3. Factory Mutual (FM)
4. National Fire Protection Association (NFPA)
5. Underwriters' Laboratories, Inc. (UL) UL 10C - Fire Tests Door Assemblies

6. Warnock Hersey

B. Regulatory standards of the following as referenced:

1. Department of Justice, Office of the Attorney General, Americans with Disabilities Act, Public Law 101-336 (ADA).

2. CABO/ANSI A117.1: Providing Accessibility and Usability for Physically Handicap People, 1992 edition.

1.03 SUBMITTALS

A. Submittals shall be made to ME Sack Engineering.

B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. For items other than those scheduled in the “Headings” of Section 3, provide catalog information for the specified items and for those submitted.

C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into vertical format "hardware sets" indicating complete designations of every item required for each door or opening. Use specification Heading numbers with any variations suffixed a, b, etc. Include the following information:

a. Type, style, function, size, and finish of each hardware item.

b. Name and manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.

e. Explanation of all abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for hardware.

g. Door and frame sizes and materials.

h. Keying information.

i. Cross-reference numbers used within schedule deviating from those specified.

i. Column 1: State specified item and manufacturer.

ii. Column 2: State prior approved substituted item and its manufacturer.

2. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.

3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

C. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

D. Contract closeout submittals:

1. Operation and maintenance data: Complete information for installed door hardware.

2. Warranty: Completed and executed warranty forms.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.

2. Required supplier to meet with installer prior to beginning of installation of door hardware.

C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and tested by UL or Warnock Hersey for given type/size opening and degree of label. Provide proper latching hardware, door closers, approved-bearing hinges and seals whether listed in the Hardware Schedule or not. All hardware shall comply with

standards UBC 702 (1997) and UL 10C. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL labels indicating "Fire Door to be equipped with Fire Exit Hardware") provide UL label on exit devices indicating "Fire Exit Hardware".

1.05 PRODUCT HANDLING

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.06 WARRANTY

Door closers shall have a ten-year warranty period.

1.07 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Parts kits: Furnish manufacturers' standard parts kits for locksets, exit devices, and door closers.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS
(* Denotes manufacturer referenced in the Hardware Headings)

A. Hinges

1. Acceptable manufacturers: Equal to Hager Hinge Company, Stanley Works, Mont Hard*.

2. Characteristics

a. Templates: Provide only template-produced units.

b. Screws: Provide Phillips flat-head screws complying with the following requirements:

i. For metal doors and frames install machine screws into drilled and tapped holes.

ii. Finish screw heads to match surface of hinges or pivots.

c. Hinge pins: Except as otherwise indicated, provide hinge pins as follows:

i. Out-Swing Exterior Doors: Non-removable pins.

ii. Out-Swing Corridor Doors with Locks: Non-removable pins.

iii. Interior Doors: Non-rising pins.

iv. Tips: Flat button and matching plug. Finished to match leafs.

d. Size: Size hinges in accordance with specified manufacturer's published recommendations.

e. Quantity: Furnish one pair of hinges for all doors up to 5'0" high. Furnish one hinge for each additional 2-1/2 feet or fraction thereof.

B. Cylinders

1. Acceptable Manufacturers: Equal to Schlage Lock, Division of Ingersoll-Rand*.

2. Characteristics

a. Multiple-Building System: Except as otherwise indicated, provide new grand master key system for Project.

b. Equip locks with high-security cylinders that comply with performance requirements for Grade 1 cylinders as listed in ANSI/BHMA A156.5 and that have been tested for pick and drill resistance requirements of UL 437 and are UL listed.

c. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

d. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."

e. Key Material: Provide keys of nickel silver only.

f. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system. Furnish one extra blank for each lock. Deliver keys to Owner.

C. Locksets, Latchsets, Deadbolts

1. Acceptable Manufacturers: Equal to Schlage, Division of Ingersoll-Rand*.

2. Mortise Locksets and Latchsets: as scheduled.

a. Chassis: cold-rolled steel, handing field-changeable without disassembly.

b. Latchbolts: 3/4-inch throw stainless steel anti-friction type.

c. Lever Trim: through-bolted, accessible design, cast or solid rod lever as scheduled. Spindles: independent break-away.

d. Thumbturns: accessible design not requiring pinching or twisting motions to operate.

e. Deadbolts: stainless steel 1-inch throw.

f. Electric operation: Manufacturer-installed continuous duty solenoid.

g. Strikes: 16 gage curved stainless steel, bronze, or brass with 1" deep box construction, lips of sufficient length to clear trim and protect clothing.

h. Scheduled Lock Series and Design: Schlage L series, 07A design.

i. Certifications:

ii. ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.

ii. ANSI/ASTM F476-84 Grade 30 UL Listed.

D. Closers and Door Control Devices

1 Acceptable Manufacturers: Equal to LCN Closers, Division of Ingersoll-Rand*.

2. Characteristics

a. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder.

b. All closers shall utilize a stable fluid withstanding temperature range of 120□F to -30□F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UBC 7-2 (1997) and UL 10C.

c. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and back check.

d. All closers shall have solid forged steel main arms (and forearms for parallel arm closers) and where specified shall have a cast-in solid stop on the closer shoe (“CNS”). Where door travel on out-swing doors must be limited, use “CNS” or “S-CNS” type closers. Auxiliary stops are not required when cush type closers are used.

e. Overhead concealed closers shall have spring power adjustable for 50% increase in closing power and fully mortised door tracks.

f. All surface closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory. All closers (overhead, surface and concealed) shall be of one manufacturer and carry manufacturer's ten-year warranty (electric closers to have two year warranty).

g. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped provide adjustable units complying with ADA and ANSI A-117.1 provisions for door opening force.

h. Closers to be installed to allow door swing as shown on plans. Doors swinging into exit corridors shall provide for corridor clear width as required by code. Where possible, mount closers inside rooms.

i. Powder coating finish to be certified to exceed 100 hours salt spray testing by ETL, an independent testing laboratory used by BHMA for ANSI certification.

E. Overhead Door Holders

1. Acceptable Manufacturers: Equal to Glynn Johnson*, Division of Ingersoll- Rand, Rixson Firemark.

2. Characteristics: Provide heavy duty door holders surface mounted stainless steel.

F. Floor Stops and Wall Bumpers

1. Acceptable Manufacturers: Equal to Glynn Johnson, Division of Ingersoll- Rand*, Ives, Rockwood Manufacturing.

2. Characteristics: Refer to Hardware Headings.

G. Door Bolts/Coordinators

1. Acceptable Manufacturers: Equal to Glynn Johnson, Division of Ingersoll- Rand*, Ives, Rockwood Manufacturing.

2. Characteristics: Flush bolts to be forged brass 6-3/4" x 1", with 1/2" diameter bolts. Plunger to be supplied with milled surface one side which fits into a matching guide.

H. Thresholds

1. Acceptable Manufacturers: Equal to National Guard Products, Inc.*, Reese Industries, Zero Weatherstripping Co., Inc.

2. Types: Indicated in Hardware Headings.

I. Door Seals/Gasketing

1. Acceptable Manufacturers: Equal to National Guard Products, Inc.*, Reese Industries, Zero Weatherstripping Co., Inc.

2. Types: Indicated in Hardware Headings.

J. Silencers

1. Acceptable Manufacturers: Equal to Glynn Johnson, Division of Ingersoll- Rand*, Ives, Rockwood Manufacturing.

2. Three for each single doors; four for pairs of doors.

2.02 MATERIALS AND FABRICATION

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

1. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

2. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.

4. Do not use thru-bolts or sex bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of adequately fastening the hardware, or otherwise found in Headings. Coordinate with wood doors and metal doors and frames where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.03 HARDWARE FINISHES

A. Match items to the manufacturer’s standard color and texture finish for the latch and lock sets (or push-pull units if no latch of lock sets).

B. Provide finishes that match those established by ANSI or, if none established, match the Architect’s sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer’s standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. The designations used to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

1. Hinges: 630 (US32D) Satin Stainless Steel

2. Flush Bolts: 626 (US26D) Satin Chrome Plated Brass/Bronze

3. Locks: 630 (US32D) Satin Stainless Steel

4. Door Closers: 689 Powder Coat Aluminum

5. Push Plates: 630 (US32D) Satin Stainless Steel

6. Pull Plates: 630 (US32D) Satin Stainless Steel

7. Protective Plates: 630 (US32D) Satin Stainless Steel

8. Door Stops: 630 (US32D) Satin Stainless Steel

9. Overhead Holders: 630 Satin Stainless Steel

10. Thresholds/Weatherstripping: 627/628 (US27/US28) Aluminum

11. Continuous Hinges: Anodized to match Aluminum Frames

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to function properly with final operation of heating and ventilating equipment.

3.03 HARDWARE SCHEDULE

HEADING #AA
Door #: 101
Each Pair to Have:

3 Pair	Hinges STS BB991
1	Lockset L9070 x 07A
1	Exit device 9975L x 07A Von Duprin
1	Closer 4111-Cush SRI primer
1	Set of weatherstripping 2525C
1	Threshold 425E
1	Door bottom seal 19VA
1	Astragal 125 NA
1	Overhead door holder 79H series
1	Set of flushbolts FB6A x DP2

HEADING #BB
Door #: 102
Each Door to Have:

1-1/2 Pair	Hinges STS BB991
1	Set of weatherstripping 2525C
1	Threshold 425E
1	Door bottom seal 19VA
1	Closer 4111-Cush SRI primer Lockset L9070 x 07A

END OF SECTION

SECTION 08711
FINISH HARDWARE

PART I – GENERAL

1.01 DESCRIPTION

A. Work included: Furnish and deliver to the job site all finish hardware required to complete the work as indicated on the drawings and specified herein. Provide all trim attachments, and fastenings specified or required for proper and complete

1.02 QUALITY ASSURANCE

A. Qualifications of Manufacturers:

Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

1.03 TEMPLATES

In a timely manner to ensure orderly progress of the work, deliver templates or physical samples of the approved finish hardware items to pertinent manufacturers of interfacing items such as doors and frames.

1.04 PRODUCT HANDLING

A. Packing and Marking:

Individual package each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on the outside to indicate the contents and specific locations in the work.

B. Protection:

Use all means necessary to protect materials of this Section before, during and after delivery to the job site and to protect the work and materials of all other trades.

C. Replacement:

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 PROPRIETARY PRODUCTS

References to specific proprietary products are used to establish minimum standards of utility and quality. Unless otherwise approved by the Architect provide only the specific products. Design is based on the materials specified.

2.02 APPROVED MANUFACTURERS

A. Butts: Stanley, McKinney, Russwin.

B. Locks: Sargent, Yale, Russwin.

C. Door closers: LCN, Yale, Sargent.

D. Kick Plates: Rockwood, Russwin, Sargent.

E. Stops: Rockwood, Bladwin, Ives.

F. Thresholds: Pemlo, Zero, May.

2.03 KEYING

A. All locksets shall be keyed alike as noted on the door schedule. Furnish two (2) change keys for each lock.

B. Tag all keys to identify which door they operate.

2.04 FASTENERS

A. Furnish all finish hardware with all necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.

B. Furnish fastenings where necessary with expansion shields, toggle bolts, sex bolts, and other anchors approved by the Architect, according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer.

C. All fastenings shall harmonize with the hardware as to material and finish.

2.05 FINISHES

Finishes of all hardware shall match the finish of the locksets. Take special care to coordinate all of the various manufactured items furnished under this section, to ensure acceptably uniform finish.

2.06 TOOLS AND MANUALS

A. For hardware items that require special adjustment tools, deliver to the Owner one complete set of such tools.

B. Deliver to the Owner one set of maintenance manuals for locksets.

PART 3 – EXECUTION

3.01 Install hardware accurately fitted, securely applied, and carefully adjusted. Install in accordance with manufacturer's instructions. Use care not to injure other work when installing.

3.02 Provide and use boring jigs, mortising tools, and other special equipment and appliances as required for proper installation of hardware items.

3.03 Remove all visible hardware before painting is begun and replace afterwards.

3.04 INSPECTION

Upon completion of the installation, and as a condition of its acceptance, visually inspect all finish hardware furnished under this Section and place in optimum working condition.

END OF SECTION

SECTION 09260
METAL STUD AND GYPSUM WALLBOARD

PART 1 GENERAL

1.01 SCOPE

The work under this Section consists of furnishing all labor, materials, equipment and services necessary for the complete and satisfactory installation of metal stud and gypsum wallboard partitions as called for on the Drawings or in these Specifications.

1.02 Submittals

A. Manufacturer's Literature: Prior to beginning installation operations, the Contractor shall submit to the Engineer the manufacturer's instructions for the proper installation of all materials furnished under this item.

B. Samples for Verification: Of each type of exposed finish in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1.03 JOB CONDITIONS

A. Environmental Conditions: During and subsequent to gypsum panel application and joint finishing, temperatures within the building shall be maintained within the range of 55 to 90 degrees F. Adequate ventilation shall be provided to carry off excess moisture.

B. Job Coordination: Coordinate wallboard installation with work of other trades to minimize cutting and patching. If patching is required, it shall be unnoticeable in the finished work.

1.04 STORAGE AND PROTECTION

Deliver and store materials in manufacturer's original, unopened packaging. Protect materials from moisture, freezing and improper handling.

1.05 QUALITY ASSURANCE

Prior to commencing installation of any materials required under this Section, the Contractor shall provide the Engineer with the manufacturer's certification that the materials meet or exceed all requirements of these Specifications.

PART 2 PRODUCTS

2.01 SHAFT WALL ASSEMBLY MATERIALS

A. General: Provide materials and components complying with requirements of fire- resistance-rated assemblies indicated.

1. Provide panels in maximum lengths available to eliminate or minimize end-to- end butt joints.

2. Provide auxiliary materials complying with gypsum board shaft-wall assembly manufacturer's written recommendations.

B. Steel Framing: ASTM C 645.

1. Protective Coating: ASTM A 653/A, G40, hot-dip galvanized coating.

2. Deflection Limit: L/240.

C. Gypsum Liner Panels: Manufacturer's proprietary liner panels in 1-inch (25.4-mm) thickness and with moisture-resistant paper faces.

D. Gypsum Wallboard: ASTM C 36, core type as required by fire-resistance-rated assembly indicated.

1. Edges: Tapered.

E. Track (Runner) Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft-wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Powder-Actuated Fasteners: Provide powder-actuated fasteners with capability to sustain, without failure, a load equal to 10 times that imposed by shaft-wall assemblies, as determined by testing conducted by a qualified independent testing agency according to ASTM E 1190.

2.02 WALLBOARD

A. Regular and Type X gypsum wallboard shall be 5/8-inch thick, tapered edge, 48-inches wide, in lengths as long as practical, conforming to ASTM C 36.

B. Gypsum panels for ceilings shall be 1/2-inch, abuse resistant, glass-mat, mold, and mildew resistant, gypsum sheathing board conforming to ASTM C630 and ASTM C1177. Provide products equal to "DENS-ARMOR PLUS" by G-P Gypsum Corp.

2.03 WALLBOARD ACCESSORIES

A. Corner Bead: Corner bead shall be formed from heavy-gauge, hot dipped galvanized steel with flange widths of at least 1-inch.

B. Dry Wall Screws: Dry wall screws shall be corrosion resistant Type S-12 Bugle Head, not less than 1-inch long for single layer and 1-1/2-inches long for double layer.

C. Joint Compound: Joint compound and finishing or topping compound shall conform with all requirements of ASTM C 475 and panel manufacturer.

D. Joint Tape

1. Interior Gypsum Wallboard: Paper.

2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

PART 3 EXECUTION

3.01 INSTALLING SHAFT WALL ASSEMBLY

A. General: Install gypsum board shaft-wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and the following:

1. ASTM C 754 for installing steel framing.

B. Install supplementary framing in gypsum board shaft-wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, and similar items that cannot be supported directly by shaft-wall assembly framing.

C. At penetrations in shaft wall, maintain fire-resistance rating of shaft-wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

D. Isolate gypsum finish panels from building structure to prevent cracking of finish panels while maintaining continuity of fire-rated construction.

E. Install control joints to maintain fire-resistance rating of assemblies.

F. Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with manufacturer's written instructions or ASTM C 919, whichever is more stringent.

3.02 GYPSUM PANEL ERECTION

A. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member. Fasten with corrosion resistant screws.

B. Attachment

1. Space fasteners not less than 3/8-inch nor more than 1/2-inch from edges and ends of wallboard. While fasteners are being driven, hold the wallboard in firm contact with the underlying support. Proceed from the central portion of the wallboard to the ends and edges. If the paper surface is broken by fastener in attachment, drive another fastener approximately 2-inches from the faulty fastener.

2. Drive screws with a mechanical tool, using a special bit to provide screwhead penetration just below wallboard surface, without breaking surface paper or stripping the framing member around the screw.

3. Space screws 12-inches on center in field of panel and 6-inches on center staggered along vertical abutting edges.

3.03 JOINT AND FASTENER TREATMENT

A. Joint Finishing Materials: Mix and use joint finishing materials in accordance with manufacturer's recommendations. Allow a minimum drying time of 24 hours between coats. Sand as necessary after each application without scuffing paper surface of board.

B. Inside Corners: Reinforce inside vertical corner angles with tape folded to conform to the adjoining surfaces and to form a straight, true angle. Provide metal trim as required.

C. Exterior Corners: Conceal flanges of corner beads and trim members with a minimum of two coats of compound, applied in accordance with manufacturer's directions.

D. Embedment Coat: Apply a thin, uniform layer of joint compound (embedding type) approximately 3-inches wide over the joint to be reinforced. Center tape over the joint and seat into the compound, leaving sufficient compound under the tape to provide proper bond. Apply a skim coat of compound immediately after embedding tape.

E. Fill Coat: After drying, apply fill coat over embedding coat by evenly spreading compound over and slightly beyond the tapered edge area of the board; feather at the edges. Sand all feathering after drying.

F. Topping: Cover fill coat with topping compound, spread evenly over and slightly beyond the edge of the preceding coat, and feather to a smooth, uniform finish. Sand all feathering after drying.

G. Fastener Concealment: Treat fastener dimples and holes as described above for joint treatment.

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as soffit board.

3.04 CLEANING

A. Maintain the work area in accordance with the requirements of Section 01710 of these Specifications.

B. At the completion of the work, remove all excess materials and debris from the site. The gypsum wallboard shall be left ready to receive painting, vinyl wall covering or paneling as scheduled on the Drawings. The entire work area shall be left in a neat and workmanlike condition, ready for the Engineer's inspection.

END OF SECTION

SECTION 09900
PAINTING

PART 1 GENERAL

1.01 SCOPE

This Section includes, but is not necessarily limited to, standards for cleaning and painting structures and equipment described in the Drawings and Specifications. Furnish all materials, equipment, and labor necessary to complete the work.

1.02 SUBSTITUTIONS

To the maximum extent possible, all coatings shall be the products of a single manufacturer. Guidelines for determination of acceptability of product substitutions shall be obtained from ME Sack Engineering. Contractors intending to furnish substitute materials or equipment shall contact ME Sack Engineering for further instructions.

1.03 SUBMITTALS

A. All submittals shall be made to ME Sack Engineering.

B. The Contractor shall submit to the Engineer, for review, the following information concerning the materials the Contractor proposes to use in work covered by this Section:

1. A list of all components (paints or other materials) to be used in each painting system required herein.

2. A complete descriptive specification, including manufacturer's data sheet, of each component.

3. Prior to completing the purchase and delivery of the coating material selected by the Contractor, the Contractor shall obtain a letter from the material supplier stating that the selected material is suitable and compatible for application and use as directed under these Specifications, and that if properly applied will provide metal protection and a pleasing appearance for five years or longer.

4. A color chart for each product to be applied.

1.04 PAINTING REQUIREMENTS

A. Finish paint all exposed surfaces except prefinished items, anodized or lacquered aluminum, stainless steel and copper surfaces. Exposures and surfaces are defined in 3.07 of this Section. Items to be left unfinished or to receive other types of finishes, such as tile, are specifically shown on the Drawings or specified.

1. Unpainted Products: Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.

2. Shop Primed Products

    a. Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering, and other defects in the shop prime coating.

    b. Manufacturers furnishing shop primed products shall certify that cleaning was performed in accordance with specification requirements and that the specified primer was used.

    c. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or that the product is otherwise unacceptable.

3. Finish Painted Products: Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products throughout the Project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered or not of the selected color, repaint as necessary.

4. Existing Surfaces

    a. Properly protect existing finish painted items and surfaces from damage throughout the Project.

    b. Repair any damage to existing coatings repaired in accordance with the requirements of this Section, at no expense to the Owner.

5. Hardware: Remove all electrical plates, surface hardware, fittings, and fastenings prior to painting operations. These items are to be carefully stored, cleaned, and replaced upon completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.05 QUALITY ASSURANCE

A. Only those systems and components which are judged acceptable by the Engineer shall be utilized in the work covered by this item. No materials shall be delivered to the job site until the Engineer has evaluated their acceptability.

B. The following information shall be included on the label of all containers of materials supplied under this item:

1. Manufacturer's name.

2. Type of paint or other generic identification.

3. Manufacturer's stock number.

4. Color (if any).

5. Instructions for mixing, thinning, or reducing (as applicable).

6. Manufacturer's application recommendations.

7. Safety and storage information.

C. All coating material used on this Project shall be purchased specifically for this Project and furnished in new, unopened containers.

D. The Contractor shall obtain the Engineer's review of the first finished room, space, area, item, or portion of work of each surface type and color specified. The first room, space, area, item, or portion of work which is acceptable to the Engineer shall serve as the Project standard for all surfaces of similar type and color. Where spray application is utilized, the area to be reviewed shall not be smaller than 100 square feet.

1.06 TESTING EQUIPMENT

A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if the requirements of this Section are being satisfied. The specified items of equipment shall be available for the Engineer's use at all times when field painting or surface preparation is in progress:

1. Wet film gauge.

2. Surface thermometer.

3. "Surface Profile Comparator" as published by The Society for Protective Coatings (SSPC) (with magnifier and three discs).

4. "Visual Standard for Abrasive Blast Cleaned Steel", as published by SSPC (SSPC-VIS 1-89).

5. "Visual Standard for Power- and Hand-Tool Cleaned Steel", as published by SSPC 9SSPC-VIS 3).

6. Holiday (pin hole) detector (low voltage).

7. Sling-psychrometer or other on-site device used to calculate relative humidity and ambient air temperature.

8. Magnetic dry film gauge, meeting the requirements of SSPC-PA2, Type I or Type II, including calibration.

1.07 PRODUCT HANDLING

A. Delivery

1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.

2. Each container shall be clearly marked or labeled to show paint identification, date of manufacture, batch number, analysis or contents, and special instructions. At all times a copy of every component's MSDS shall be available.

B. Storage

1. Store only acceptable Project materials on the Project site.

2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state, and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.

3. Restrict storage area to paint materials and related equipment.

4. Place any material, which may constitute a fire hazard, in closed metal containers and remove daily from the Project site.

C. Material Safety Data Sheets: A copy of every component's MSDS shall be available at all times on the Project site.

1.08 MATERIAL SCHEDULES

Material Schedules at the end of this Section list prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

PART 2 PRODUCTS

2.01 COATING MATERIALS

A. Acceptable Manufacturers: The only acceptable manufacturers and products shall be those listed in the Material Schedules at the end of this Section.

B. All applicable data currently published by the paint manufacturer relating to surface preparation, coverages, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It is the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.

C. Products

1. Paints shall be factory mixed and delivered to the site in unbroken original packages bearing the manufacturer's name and brand designation and shall be applied in strict accordance with the manufacturer's printed specifications. Two-component coatings shall be mixed in accordance with manufacturer's instructions. All two-component coatings, once mixed, shall be applied within the pot-life recommended by the manufacturer.

2. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.

D. Colors: The Owner will select the colors to be used on the various portions of the work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint off-shade the paint for each undercoat to show complete coverage.

2.02 MIXING AND TINTING

A. When possible, all paints and other materials shall be mixed and tinted by the paint manufacturer prior to delivery to the job site.

B. When job site mixing and/or tinting is required, the manufacturer's recommendations shall be strictly adhered to. The Contractor shall be solely responsible for the proper conduct of all on-site mixing and/or tinting.

2.03 PIPE AND EQUIPMENT IDENTIFICATION

Different colors will be used on pumps, motors, valves, piping systems and other surfaces as shown in Table 1.

2.04 OSHA SAFETY COLOR USAGE GUIDE

A. OSHA Safety colors, in accordance with ANSI Z3.1, shall be used for marking physical hazards and safety equipment and locations. The following OSHA Safety Color Usage Guide will be used in determining the coating color and type of marking required.

Safety Red	Safety Orange	Safety Yellow	Safety Green
		Physical Hazard CAUTION (Generally used with Black in checks or stripes)	Safety Equipment and Locations
Fire protection equipment	Exposed box housings	Unguarded edges of platforms	First aid kits and stretchers
Fire boxes	Exposed edges of pulleys, gears, etc.	Elevator door edges	First aid signs, dispensaries and drinking water stations
Extinguishers	Exposed box housings	Bollards	
Exit signs	Safety starting buttons	Pulley Blocks	
Sprinkler piping		Material handling equipment	
Portable containers of flammable liquids			
Emergency stop bars			

PART 3 EXECUTION

3.01 GENERAL

A. Protect other surfaces from paint and damage. Furnish sufficient shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Repair damage as a result of inadequate or unsuitable protection.

B. The Contractor's on-site representative shall keep a record of work performed each day and shall submit it to the Engineer weekly. The forms for this record will be furnished by the Engineer.

C. No coat of paint shall be applied until the surface has been inspected and accepted by the Engineer. The Contractor shall give at least 24 hours notice to the Engineer when cleaning is to be performed to prevent inspection delays. The Contractor shall provide the necessary access for inspection by the Engineer.

D. Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, small nozzle and abrasive particle sizes, short blast nozzle, distance from surface, shielding and masking. If

damage is too extensive or uneconomical to touch-up, then the item shall be re-cleaned and coated or painted as directed by the Engineer.

3.02 ENVIRONMENTAL CONDITIONS

A. Environmental conditions which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

B. Surface preparation and cleaning of the exterior surfaces must be performed during periods of still air or only a slight breeze so that fallout of the dust produced does not drift onto adjacent property. The Owner reserves the right to temporarily stop the Contractor from exterior blasting (or painting) when by observation it is apparent that the wind direction or velocity prevents compliance with this requirement. Any clean-up of fall-out on adjacent property shall be the responsibility of the Contractor.

C. No paint shall be applied upon damp or frosty surfaces, or in wet or foggy weather. No paint shall be applied in temperatures below 40 degrees F, when freezing (32 degrees F) is predicted within 24 hours of application, or under temperature or humidity conditions not recommended by the manufacturer. However, in no case shall coatings be applied when the surface temperature is within 5 degrees F of dew point, and in no cases shall coating be applied over a damp surface.

3.03 SAFETY

A. GENERAL

1. The Contractor is responsible for the safety of all workers and subcontractors and suppliers performing work on this Project.

2. The Contractor shall protect the Owner, their agents, and the General Public from harm attributable to the Contractor's performance, or non-performance, of the work on this Project. The protection shall include, but not be limited to, providing the necessary safety equipment and instructions for its use by the Owner, and their agents.

3. The Contractor shall protect the existing structures and environment from damage attributable to the Contractor's performance, or non-performance, of the work on this Project.

4. The Contractor shall comply with the applicable standards of 29 CFR Part 1910 and 29 CFR Part 1926.

5. The listing of the following potential hazards shall in no way relieve the Contractor's responsibility for safety on this Project.

3.04 SURFACE PREPARATION

A. General: All surfaces shall be thoroughly clean, dry, and free from oil, grease, or dust. All concrete shall have cured a minimum of 21 days before painting. All fabricated metal products shall have all weld flux and weld spatter removed and sharp peaks in welds ground smooth. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.

B. Ferrous Metals: Standards for the surface preparation of ferrous metals required in the Material Schedules are the standards of the SSPC – The Society for Protective Coatings (SSPC, SP-1 through SP-10). Inspection of these surfaces will be evaluated by field comparison with visual comparator panels. These panels shall be securely wrapped in clear plastic and sealed to protect them from deterioration and marring.

C. Concrete Surfaces: For all concrete surfaces, the following surface preparation shall be employed:

1. CC-1 - Wash: Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water. After this washing the surface will be re-checked and any rough areas not suitable for painting shall be sandblasted smooth.

2. CC-2 - Acid Etch: Surface preparation for painting shall not commence until 7 days after the concrete has been pronounced cured. Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water and then etch the surface with a 15 percent or stronger solution of muriatic acid until an open-faced granular texture, similar to fine sandpaper, is obtained. Any areas that remain smooth are to be re-etched until the desired texture is achieved. Flush and scrub away with clear water all acid and loosened particles.

3. CC-3 - Blast Cleaning: Remove all form oil and dirt by washing the surface with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Blast clean all laitance and other foreign material from the surface of the concrete until an openfaced granular texture similar to fine sandpaper is achieved. These results should be accomplished with blast cleaning similar to "brush blasting" steel surfaces.

D. Wood Surfaces: All wood surfaces shall be clean, dry, and adequately protected from dampness. Sandpaper to a smooth, even surface, then dust off. After priming coat has dried, apply shellac to all knots, pitch, and resinous sapwood. Putty all nail holes, cracks, open joints, and other defects; color putty to match finish paint or stain.

3.05 APPLICATION

A. Surface Preparation: After specified surface preparation, all surfaces shall be brushed free of dust or foreign matter. Surfaces shall be completely dry before any paint is applied. All voids, open or hollow places in masonry shall be repaired with an epoxy patching compound.

B. Application: Paint shall be evenly spread in the proper thickness, so that there shall be no drops, runs or saggings of the coating. Where runs and drops do occur, they shall be removed and the surface re-coated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer, shall be allowed for the paint to dry before the application of succeeding coats.

C. Protection of Work Area: Use drop cloths or other suitable means to protect other surfaces of the structure or equipment in place. Upon completion of the work, remove all paint spots from surfaces as directed by the Engineer.

D. Inspection: The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed.

E. Defective Work: Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.

3.06 PAINTING SCHEDULE

A. General: The Painting Schedule summarizes the painting systems to be applied to the various surfaces. Items which appear in the Painting Schedule are defined in following paragraphs.

B. Exposure terms refer to the environmental conditions to which different surfaces may be exposed. A surface may exist in more than one exposure, e.g., an exterior wall can be categorized not only as "above grade", but also as "below grade", where the exposure is delimited by the grade line.

1. Interior: All surfaces within the confines of a building or other enclosure not constantly exposed to weather, including concealed surfaces subject to trapped moisture, heat or other deteriorating conditions and all surfaces exposed to view.

2. Exterior

a. Above Grade: All surfaces above finished grade and exposed to weather.

b. Below Grade: All surfaces below the finished grade line. Building surfaces with this exposure shall only be painted when they are structurally common with an interior surface, e.g., exterior walls of a dry pit, not the exterior wall of a below grade tank.

3. Submerged: All surfaces below a water surface or exposed to spray. Surfaces exposed to spray includes all areas within 6-inches of maximum water surface in quiescent tanks and within 18-inches of maximum water surface in mixed or agitated tanks. Building surfaces with this exposure shall only be painted when surfaces above water level have an interior exposure.

C. Surfaces

1. Floors: Interior surfaces subject to foot or roller traffic.

2. Building Surfaces: All structural and architectural surfaces except floors. Building surfaces include, but are not limited to, doors and frames, windows and frames, floor doors and walls.

3. Piping: All plumbing and process piping and accessories including valves, fittings, pipe supports, electrical conduit and similar related items.

4. Equipment: All mechanical, electrical, and architectural equipment, items, and accessories installed in the work and not defined above. Equipment includes, but is not limited to: pumps, motors, cabinets, ducts, tanks, and process equipment.

3.07 MATERIAL SCHEDULES

Material Schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

3.08 MAINTENANCE MATERIALS

Furnish the Owner at least one gallon of each type and color of paint used for finish coats and one gallon of each type of thinner required. Containers shall be tightly sealed and clearly labeled.

3.09 COATING REPAIR

Where coatings have been damaged, the surfaces shall be cleaned and repainted. Surface preparation shall conform to SSPC-SP 11, and feathered into undamaged areas. Painting shall be performed as specified for the damaged surface.

END OF SECTION

SECTION 12360
LABORATORY CASEWORK

PART 1 GENERAL

1.01 GENERAL

A. Laboratory equipment and facilities shall be compatible with the raw water source, intended design of the treatment plant, daily monitoring and the complexity of the treatment process involved.

B. Recognized laboratory procedures must be utilized, and the testing equipment shall be acceptable to the Division.

C. Laboratory facilities and any other part of the water treatment plant should not be used for activities and/or purposes that are not pertinent to the operation of the plant or in the execution of the duties of the operator and/or the laboratory analyst.

D. Sufficient bench space, adequate ventilation, adequate lighting, storage room, laboratory sink, and auxiliary facilities shall be provided.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

A. Section Includes:

1. Wood laboratory casework.
2. Filler and closure panels.
3. Laboratory countertops.
4. Shelves.
5. Laboratory sinks.
6. Water, laboratory gas, and electrical service fittings.

B. Related Sections:

1. Division 11 Section “Laboratory Fume Hoods” for fume hoods, including base cabinets and countertops under fume hoods.

2. Divisions 15 and 16 Sections for installing service fittings specified in this Section, including connecting service utilities.

1.04 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inched above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets are defined as “exposed.”

2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as “concealed.”

B. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as “semi-exposed.”

C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

D. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive faced both front and back with hardwood veneers.

1.05 SUBMITTALS

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

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware and keying of locks.
2. Indicate locations and types of service fittings.
3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
4. Include details of exposed conduits, if required, for service fittings.
5. Indicate locations of and clearances from adjacent walls, doors, windows, and other building components, and other laboratory equipment.
6. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

D. Qualification Data: For qualified manufacturer.

E. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product.

F. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8.

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated. Obtain countertop sink accessories and service fittings from casework manufacturer.

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."

D. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture – Casework, Shelving, and Tables – Recommended Practices."

E. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operation and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.09 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

PART 2 – PRODUCTS

2.01 WOOD CABINET MATERIALS

A. General:

1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
2. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated.
3. MDF: ANSI A208.2, Grade 130.
4. Particleboard: ANSI A208.1, Grade M-2.
5. Hardboard: AHA A135.4, Class 1 Tempered.
6. Edgebanding for Wood-Veneered Construction: Minimum 1/8-inch thick, solid wood of same species as face veneer.

B. Exposed Materials:

1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings.
2. Plywood: Hardwood Plywood with face veneer of species indicated, selected for compatible color and grain. Grade A exposed faces at least 1/50 inch thick, and Grade J crossbands. Provide backs of same species as faces.

    a. Face Veneer Cut: Plain sliced.

3. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed hardwood plywood.

C. Semi-exposed Materials:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of any species similar in color and grain to exposed solid wood.
2. Plywood: Hardwood plywood of any species similar in color and grain to exposed plywood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.
3. Provide solid wood or hardwood plywood for semi-exposed surfaces unless otherwise indicated.

D. Concealed Materials

1. Solid Wood: Any species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Provide backs of same species as faces.
3. Particleboard
4. MDF.
5. Hardboard.

2.02 COUNTERTOP SHELF and SINK MATERALS

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Colors, Patterns & Finishes: As selected by Architect from plastic-laminate manufacturer's full range.

B. Core Materials for Plastic Laminate: Particleboard, ANSI A208.1, Grade M-2.

C. Adhesive for Bonding Plastic Laminate: Manufacturer's standard waterproof adhesive.

D. Epoxy: Factory –molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Durcon Company (The).
b. Epoxyn Products.

c. Laboratory Tops, Inc.
d. Prime Industries, Inc.

2. Physical Properties:

a. Flexural Strength: Not less than 10,000 psi.
b. Modulus of Elasticity: Not less than 2,000,000 psi.
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F.

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5.

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28 percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.
b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

4. Color: As selected by Architect from manufacturer's full range.

2.03 WOOD CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advanced Lab Concepts, Inc.
2. CampbellRhea.
3. CiF Furniture Ltd.
4. Collegedale Casework, LLC.
5. Diversified Woodcrafts, Inc.
6. Fisher Hamilton, L.L.C.
7. Keur Industries, Inc.
8. Kewaunee Scientific Corporation; Laboratory Products Group.
9. Laboratory Design & Supply.
10. Leonard Peterson & Company, Inc.
11. Sheldon Laboratory Systems.
12. South Texas Woodmill, Inc.
13. Terrill Manufacturing Company.

B. Design: Reveal overlay with radiused edges. Provide 1/8-inch reveals between doors and drawers that are adjacent.

C. Grain Direction:
   1. Vertical on both doors and drawer fronts, with continuous vertical matching.
   2. Lengthwise on face frame members.
   3. Vertical on end panels.
   4. Side to side on bottoms and tops of units.
   5. Vertical on knee-space panels.
   6. Horizontal on aprons and table frames.

D. Veneer Matching:

   1. Provide veneers for each cabinet from a single flitch, book and running matched. Provide continuous matching of adjacent drawer fronts within each cabinet.

E. Construction: Provide wood-faced laboratory casework of the following minimum construction:

   1. Bottoms of Base Cabinets and Tall Cabinets: ¾-inch thick veneer-core hardwood plywood.
   2. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1-inch thick veneer-core hardwood plywood.
   3. Ends of Cabinets: ¾-inch thick hardwood plywood.
   4. Shelves: 1-inch thick veneer-core hardwood plywood
   5. Base Cabinet Top Frames: ¾-by-2-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
   6. Backs of Cabinets: ¾-inch thick, particleboard- or MDF-core hardwood plywood where exposed, ¼ -inch thick, hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
   7. Drawer Fronts: ¾-inch thick, particleboard- or MDF-core hardwood plywood or solid hardwood.
   8. Drawer Sides and Backs: 1/2-inch thick, solid hardwood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
   9. Drawer Bottoms: ¼-inch thick, veneer-core hardwood plywood glued and dadoed into front, back and sides of drawers. Use ½-inch thick material for drawers more than 24 inches wide.
   10. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard or MDF cores, solid hardwood stiles and rails, and hardwood face veneers and crossbands.
   11. Doors More than 48 Inches High: 1-1/8 inches thick, with particleboard cores and hardwood dace veneers and crossbands.

F. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.

1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.

2.04 WOOD FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges or doors, drawer fronts, and molded shapes with profile-edge sander. Sand after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply stain to exposed and semiexposed surfaces as necessary to match approved Samples. Apply stain in a manner that will produce a consistent appearance. Apply wash-coat sealer before applying stain to closed-grain wood species.

1. Stain Color: As selected by Architect from manufacturer's full range.

C. Chemical-Resistant Finish: Apply laboratory casework manufacturer's standard three-coat, chemical-resistant, transparent finish. Sand and wipe clean between coats. Topcoat(s) may be omitted on concealed surfaces.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2.05 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.

C. Hinges for Wood Cabinets: Frameless concealed hinges (European type) complying with A156.9, Type B01602, 170 degrees of opening, self-closing.

D. Hinged Door and Drawer Pulls: Solid aluminum, stainless steel, or chrome-plated brass back-mounted pulls. Provide 2 pulls for drawers more than 24 inches wide.

    1. Design: Wire pulls.
    2. Overall size: 1-1/4 by 4-1/2 inches.

E. Sliding Door Pulls: Stainless-steel or chrome-plated recessed flush pulls.

    1. Design and Size: As selected from manufacturer's full range.

F. Pulls: Recessed aluminum pulls. Provide 2 pulls for drawers more than 24 inches wide.

G. Pulls for Wood Cabinets: Full-width, recessed solid hardwood channels; matching exposed wood of cabinets.

H. Door Catches: Dual, self-aligning, permanent magnet catches. Provide 2 catches on doors more than 48 inches high.

I. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

    1. Provide Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
    2. Provide Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
    3. Standard Duty (Grade1): Full-extension type, with polymer rollers.
    4. Heavy Duty (Grade 1HD-100 and Grade 1 HD-200): Full-overtravel-extension, ball-bearing type.

J. Drawer Slides for Wood Cabinets: Hardwood runners under centers of drawers with polymer guides fastened to backs of drawers.

K. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on all drawers.

L. Locks for Wood Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281 or E07261.

    1. Provide a minimum of two keys per lock and two master keys.
    2. Provide on all drawers and doors.
    3. Keying: Key locks within each room alike, key each room separately.

4. Master Key System: Key all locks to be operable by master key.

M. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

N. Adjustable Shelf Supports for Wood Cabinets: Power-coated steel shelf rests complying with BHMA A156.9, Type B04013.

O. Adjustable Shelf Supports for Wood Cabinets: Mortise-type, powder –coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04112.

2.06 COUNTERTOPS, SHELVES, TROUGHS, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside ½ inch from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.

1. Outlets: Provide with strainer and tailpieces, NPS 1-1/2, unless otherwise indicated.
2. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.

C. Plastic-Laminate Shelves:

1. Plastic-Laminate Shelves: Plastic laminate shop bonded to both faces and all edges of 1-inch thick core. Sand surfaces to which plastic laminate is to be bonded.
   a. Shelf Core: Particle board Urea-formaldehyde-free particle board Exterior-glue particle board straw-based particle board or exterior plywood.
   b. Plastic-Laminate Grade for Shelves: HGL.

D. Epoxy Countertops and Sinks:

1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.

a. Countertop Configuration: Flat, ¾ inch thick, with beveled or rounded edge or corners, and with drip groove and integral coved or applied backsplash.
b. Countertop Construction: Uniform throughout full thickness.

2. Sink Fabrication: Molded in 1 piece with smooth surfaces, coved corners, and bottom sloped to outlet, ½-inch minimum thickness.

a. Provide with polypropylene strainers and tailpieces.
b. Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.
c. Provide manufacturer's recommended adjustable support system for table- and cabinet-type installations.

3. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandy soils.

2.07 WATER AND LABORATORY GAS SERVICE FITTINGS

A. Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures – Recommended Practices." Provide fittings complete with washers, locknuts, nipples and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.

B. Materials: Fabricated from cast or forged red brass unless otherwise indicated. Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.

C. Finish: Acid- and solvent-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminum, white or other color as approved by Architect.

D. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig.

1. Vacuum Breakers: Provide ASSE 1035 vacuum breakers on water fittings with serrated outlets.
2. Aerators: Provide aerators on water fittings that do not have serrated outlets.
3. Self-Closing Valves: Provide self-closing valves where indicated.

E. Hand of Fittings: Furnish right-hand fittings unless fitting designation is followed by "L."

PART 3- EXECUTION

3.01 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches. o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Where base cabinets are installed from walls, fasten to floor at toe space at not more than 24 inches o.c and at sides of cabinets not less than 2 fasteners per side.

C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches. o.c.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

C. Fastening: Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches. o.c. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness and appearance.

D. Provide required hole and cutouts for service fittings.

E. Provide scribe moldings for closures at junctures of countertop, curb and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.04 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table-and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.05 INSTALLATION OF SERVICE FITTINGS:

A. Comply with installation requirements in Division 15 and 16 Sections for installing water and laboratory gas service fittings and electrical devices.

B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink and countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.06 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c

END OF SECTION

SECTION 13100
PRE-ENGINEERED METAL BUILDINGS

PART 1- GENERAL

1.01 SCOPE

A. These specifications define the materials, products, design criteria, and fabrication of the metal building system required to withstand the forces imposed by snow, wind, seismic activity, structural movement including thermal expansion and contraction as well as in-service use conditions imposed upon the building structure.

B. These specifications are an outline of material as well as performance requirements to insure that the architect, engineer, builder and owner understands the basis for design, manufacture, and application of the metal building system.

C. Embedded anchor bolts shall be provided where indicated on the Drawings or in the Specifications or where recommended by equipment manufacturers.

D. Eave height dimension of pre-engineered metal building cover over the In-Plant Pump Station Wet Well shall be 14’-0” above the top of the wet well slab. Coordinate heights of other pre-engineered building covers with ME Sack Engineering.

1.02 BUILDING DESCRIPTION

Rigid Frame Clear Span: Rigid frame clear span is a solid web continuous frame design with either tapered or uniform depth (straight) columns.

1.03 QUALITY ASSURANCE

A. The metal building manufacturer shall be a certified member of the (AISC) American Institute of Steel Construction, Metal Building Manufacturers Association (MBMA), and Systems Builders Association (SBA).

B. Approved Building System Manufacturers:

1. A & S Building Systems
2. American Buildings Company
3. Butler Building Systems
4. Gulf States Manufacturers
5. Nucor Building Systems
6. VP Buildings

C. All Building system manufacturer’s drawings and design analysis shall bear the respective seal of a registered professional engineer. This submittal shall include all necessary Special Inspections documents pertaining to the pre-engineered

metal building. It is the responsibility of the pre-engineered building engineer to provide special inspection documents for their scope of work.

D. Qualifications of welders: Welders shall be qualified in accordance with AWS D1.1.

E. Qualifications of erectors: The erector shall be routinely engaged in similar size projects as well as complexity for a minimum of five years. The erector shall be familiar and experienced with the building system manufacturer.

PART 2- STRUCTURAL STEEL DESIGN

2.01 GENERAL

A. The building manufacturer shall use standards, specifications, recommendations, findings and/or interpretations of professionally recognized groups such as AISC, AISI, AAMA, AWS, ASTM, MBMA, Federal Specifications, and published research by MBMA as the basis for establishing design, drafting, fabrication, and quality criteria, practices, and tolerances. For convenience, one or more source may be referenced in a particular portion of these specifications.

B. Structural mill sections or welded up plate sections shall be designed in accordance with AISC's "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

C. Cold-formed steel structural members shall be designed in accordance with AISI's "Specification for the Design of Cold-formed Steel Structural Members."

2.02 DESIGN LOADS

A. Design loads shall be as specified and set forth in the 2012 International Building Code with Georgia State Amendments. Design loads shall include roof live load, applicable snow loads, wind loads, seismic loads, and collateral loads. It also includes any auxiliary equipment loads, and/or specific loads.

B. Dead Load: The actual weight of the building system that is determined by the manufacturer.

C. Roof Live Load: The load produced by maintenance activities, rain, erection activities, and other movable or moving loads, but not including wind, snow, seismic, crane, or dead loads.

D. Roof Snow Load: The gravity load induced by the weight of snow or ice on the roof, assumed to act on the horizontal projection of the roof.

E. Wind Load: The load on a structure induced by the forces of wind blowing from any horizontal direction.

F. Collateral Load: The weight of any non-moving equipment or material, such as ceilings, electrical or mechanical equipment, sprinkler systems, or plumbing.

G. Auxiliary Load: The dynamic load induced by cranes, conveyors, or other material handling systems.

H. Seismic Load: The horizontal load acting in any direction on a structural system due to action of an earthquake.

PART 3- BASIC MATERIAL SPECIFICATIONS

3.01 PRIMARY FRAMING STEEL

A. Steel for hot-rolled shapes shall conform to the requirements of ASTM Specifications A36, with a minimum yield of 36, 42, or 50 ksi.

B. Plate steel for built-up sections shall conform to the physical requirements of ASTM A570, ASTM 572 or ASTM A36 as applicable, with minimum yield of 42,000, 50,000, or 55,000 psi as indicated by the design requirements.

C. Steel for endwall “C” sections shall conform to the physical requirements of ASTM A607 Grade 55 and have a minimum yield of 55,000 psi.

3.02 SECONDARY FRAMING STEEL

Steel used to fabricate (form) purlins, girts, eave struts, and “C” sections shall conform to the physical requirements of ASTM A607 Grade 55 and have a minimum yield of 55,000 psi.

3.03 ROOF PANEL MATERIAL

Panel material as specified shall be 24 gauge steel-coated both sides with a layer of aluminum-zinc alloy (approximately 55% aluminum, 45% zinc) applied by a continuous hot-dip method. Triple spot minimum 0.55 ounce per square foot as determined by the Triple Spot Test per ASTM Specification A792.

PART 4- STRUCTURAL SYSTEM FRAMING

4.01 GENERAL

A. All framing members shall be manufactured and fabricated for field bolted assembly. All connection plates including all purlin and girt clips are to be factory welded.

B. All shop connections shall be in accordance with AISC and AWS.

C. All framing members shall bear an easily identifiable piece mark.

4.02 PRIMARY STRUCTURAL FRAMING

A. Rigid Frames: All primary frames shall be factory welded, built-up “I” sections. The columns and rafters may be either tapered or uniform depth. Flanges shall be connected to webs by means of a continuous fillet weld on either one side or both sides, depending upon design requirements. Rigid frames shall be used in lieu of standard endwall frames.

B. Plates, Stiffeners, etc.: All base plates, splice plates, end plates, clips, and stiffeners shall be factory welded into place on the structural members.

C. Bolt Holes: All base plates, splice plates, and clips shall be factory fabricated to include all bolt connections. Any field cutting of frames is prohibited.

D. Secondary connections: All connections for secondary structural including purling, girts, and eave struts shall be by means of factory welded, four bolt pattern clips. Clips shall be factory welded to primary structural.

4.03 SECONDARY FRAMING

A. Purlins and Girts: Roof purlins and wall girts shall be cold formed, 8”, 10”, or 12” deep “Z” sections with stiffened flanges. Depth of “Z” sections shall be determined by engineering criteria. All purlins and girts shall be factory pre-punched to accommodate field bolting to the primary frames. Connection bolts will install through the web of the “Z,” not through the flanges.

B. Eave Struts: All eave struts shall be unequal flange cold-formed “C” sections.

4.04 BRACING

A. Portal Frame Bracing: may be designed.

B. Fixed Base Bracing: may be designed.

NOTE: Design criteria determines whether portal frame bracing or fixed base bracing will be designed

C. Flange Braces: The compression flange of all primary framing shall be braced laterally with angles connecting to the webs of purlins or girts so that the flange compressive stress is within allowable limits for any combination of loading.

PART 5- ROOF COVERING

5.01 GENERAL

PBR roof panels as specified shall be 24 gauge steel, coated both sides with an aluminum-zinc alloy.

5.02 PANEL DESCRIPTIONS

PBR Panel: Panels shall have four (4) major ribs 1 1/4” high, spaced 12” on center. Between the major corrugations are two (2) minor corrugations. All sidelaps shall be composed of one major rib from each adjacent panel utilizing the underlying purlin bearing rib for support. Each panel shall provide 36” net coverage in width.

PART 6- MISCELLANEOUS MATERIAL SPECIFICATIONS

6.01 BOLTS

Structural Bolts: All bolts used in primary frame splices, endwall framing connections, connections of secondary framing to primary framing, and secondary framing to secondary framing shall be zinc plated ASTM A307 or ASTM A325 as required by design.

6.02 FASTENERS

Roof panel fasteners vary depending upon required finishes and required insulation thickness. Listed below are available fastener specifications and recommended sized for differing insulations.

A. Self-drilling structural screws shall be carbon steel No. 12-14 x 1 1/4” Hex Head, cadmium or zinc plated. The fastener shall be assembled with EPDM washer to insure a waterproof seal. Hex head of fastener shall be coated with OxySeal II™ for long life corrosion protection and then color coated if required. These fasteners are applicable for use with fiberglass blanket insulation from 0” to 4” thick.

B. Self-drilling structural screws shall be carbon steel No. 12-14 x 1 1/4” Indented Hex Head cast from Zamak-5, and alloy of zinc, aluminum and manganese that completely encapsulates the head of the self-drilling insert. Fastener shall be assembled with EPDM washer to insure a waterproof seal. The ULTIMATE™ fastener is available color coated and non-color coated. These fasteners are applicable for use with fiberglass blanket insulation for 0” to 4” thick.

C. Self-drilling structural screws shall be 410 corrosion resistant stainless steel No. 12-14 x 1 1/4” Hex Head with the EPDM washer. Color coated and non-color coated heads are available. The fasteners are applicable for use with insulation from 0” to 4” thick.

D. Self-drilling sidelap, panel to panel screws shall be No. 14 x 7/8” with EPDM washer. This fastener is used regardless of panel type. The finish on this fastener will be provided to match the self-drilling structural screws specified.

6.03 GUTTER, DOWNSPOUTS, AND RELATED FLASHING

A. Eave Line Gutters: The gutters shall be 24 gauge AZ50 aluminum-zinc coated steel substrate with a pre-painted finish.

B. Downspouts: Downspouts shall be 26 gauge aluminum-zinc alloy coated steel pre- painted, rectangular in shape.

C. Flashings: The flashings shall be a minimum of 26 gauge AZ50 aluminum-zinc alloy coated steel pre-painted finish per customer's request.

6.04 CLOSURES AND SEALANTS

A. Closure Strips: The corrugations of the roof panels shall be filled with solid or closed cell, non-shrinking, performed, neoprene or polyethylene closures at the eave, ridge and rake when required for Weathertightness.

B. Metal Closures: The corrugations and pan area shall be filled with formed metal closures. The outside closures shall be formed from 24 gauge steel. The inside closures shall be formed from 18 gauge steel. The closure exterior shall be aluminum- zinc alloy or pre-painted AZ50 aluminum-zinc alloy coated steel.

C. Sealants: Roof panels shall be sealed as with 3/32" x 3/8" wide tape sealer. This material shall be butyl base elastic compound with a minimum solid content of 99%, Schnee-Morehead No. 5225 or equal. The sealer shall be non-staining, non-corrosive, non-shrinking, non-oxidizing, non-toxic and non-volatile. The service temperature shall be from –60° F to 300° F.

D. Sealants (optional): Endlap, ridge, gable and eave sealers are butyl-based pressure sensitive 7/8" x 3/16" tape mastic, non-staining, non-corrosive, non-volatile and non- toxic. The tape is 100 polyisobutylene-isoprene meeting the performance requirements of Federal Specification TT-C-1796A, Type II, Class B. Service temperature is from –60° F to +275° F.

E. Caulk: All gutter and downspout joints, rake flashing laps, ridge flashing laps, doors, window, and louvers shall be sealed with white or burnished slate pigmented polyurethane caulk. It shall meet or exceed the requirement of Federal Specification TT-S-00230C, Type II, Class A.

PART 7- COATING

7.01 STRUCTURAL COATING

A. All structural steel shall be hot-dipped galvanized.

B. All secondary structural framing shall be pre-galvanized coil stock.

PART 8- ERECTION AND INSTALLATION

8.01 GENERAL

The erection of the metal building and the installation of accessories shall be performed in accordance with standard practices and approved erection drawings. Erection

practices shall conform to Section 6, Common Industry Practices found in the "Low Rise Building Systems Manual," MBMA 1986. There shall be no field modifications to any structural member except as authorized and specified by building manufacturer.

PART 9- BUILDING ANCHORAGE AND FOUNDATIONS

9.01 GENERAL

The building anchor bolts shall be designed to resist the maximum column reactions resulting from the specified combinations of loading. The building manufacturer shall specify the bolt diameter and placement. The foundation shall be adequately designed by a qualified foundation engineer (Oconee Engineering) to support the building reactions and other loads that may be imposed by the building use. It is the responsibility of the metal building manufacturer to provide correct loading information to the E.O.R. for the site-specific conditions. The design shall be based on the specific soil conditions of the site.

PART 10 - WARRANTIES

10.01 GENERAL

Full warranty for all material and labor needed for the complete installation of specified pre-engineered metal buildings shall be provided for a minimum period of 10 years from the date of final project completion at no additional cost to owner.

END OF SECTION

SECTION 13601
PREFABRICATED BUILDINGS

PART 1 – GENERAL

1.01 GENERAL

A. The design of the structural system shall be a clear span rigid frame with tapered columns and roof beams.

B. The vertical live loads shall be not less than 20 psf, applied on the horizontal projection of the roof structure.

C. The building shall be designed for a wind velocity of 112 miles per hour, applied in accordance with the MBMA Building Systems Manual.

D. Actual building length shall be structural line to structural line and shall be the same as nominal (i.e., the number of bays times length of bays).

E. Actual building width shall be structural line to structural line and shall be nominal buildings width or widths.

F. The roof shall have a pitch of 1/2 inch in 12 inches.

1. All components and parts shall be clearly marked and erection drawings shall be supplied for identification and assembly of the parts.

2. All drawings shall carry the seal of a registered professional engineer. Registration must be in the State of Georgia.

G. Field modification of parts shall be in accordance with the best standard procedures.

H. Anchor bolts shall be as specified by the manufacturer's standard anchor bolt layout drawings.

I. Shop drawings shall be submitted to the Engineer for approval prior to fabrication.

1.02 MANUFACTURERS

A. Building manufacturer shall be a member of the American Metal Building Manufacturers Association.

B. Manufacturers of prefabricated buildings will be accepted on the basis of Prior Approval as required in Section 01001 General Requirements.

1.03 DELIVERY AND STORAGE

A. Prefabricated components, sheet, panels and other manufactured items shall be delivered, stored and handled in such a manner that they will not be damaged or deformed. Materials stored on the site before erection shall be stacked on platforms or pallets and covered with tarpaulins or other suitable weathertight covering. All metal sheets or panels shall be stored so that water which might have accumulated during transit or storage will drain. The sheets or panels shall not be stored in contact with materials which might cause staining. Upon arrival on the job site, the sheets or panels shall be inspected for moisture accumulation. If found wet, the moisture shall be removed and the sheets or panels shall be restacked and protected until used.

PART 2 – MATERIALS

2.01 STEEL FRAMEWORK

A. In accordance with the Manual of Steel Construction of the American Institute of Steel Construction.

B. Steel framing less than 3/16 inch thick shall be in accordance with the American Iron and Steel Institute's Design of Cold Formed Structural Members. [Prefabricated sections of the framework shall be designed for re-erection and shall be assembled in a manner which will assure the maximum strength and rigidity.]

2.02 SIDING AND ROOFING

A. Sheets or panels shall be steel conforming to the following requirements:

1. One type of siding and one type of roofing shall be used throughout the project.

2. Steel sheets or panels shall be not less than 24 gauge. Zinc coated sheets conforming to the requirements of ASTM A446, except that the ordered weight of zinc coating for all gauge shall be 1.50 ounces per square foot (3/4 ounce each face).

3. The sheets or panels shall be either the deep corrugated type or the panel type.

a. The deep corrugated type shall have corrugations, V-beams, ribs, channels or other similar configurations.

b. The panel type shall have either configurations or interlocking ribs not less than 1 1/2 inches deep.
c. Sheets or panels should be applied in full wall heights from base to eve with no horizontal joints except at the junctions of door frames, louver panels and similar location.

B. Siding and roofing sheets or panels shall receive a factory color coating applied to the exterior faces of sheets or panels.

1. The color finish for wall panels shall be guaranteed by the building manufacturer for ten years against blistering, peeling, cracking, flaking, checking and chipping.

2. Excessive color change and chalking shall be guaranteed for ten years.

C. Durability of roofing panels due to rupture, structural failure of perforation shall be guaranteed for a period of ten years.

D. Interior faces of wall sheets or panels shall receive the manufacturer's standard pretreatment and prime with a factory applied alkyd or vinyl finish color coat.

2.03 FASTENERS FOR SECURING SHEETS AND PANELS

A. Fasteners for attachment to structural supports and fasteners for attachment to adjoining sheets or panels shall be as approved, and in accordance with the manufacturer’s recommendations.

B. The fastening system shall be designed to withstand the design loads specified hereinafter.

C. Fasteners shall be stainless or cadmium plated steel.

D. All fasteners, with the exception of those having integral hex washer heads, shall have composite metal and neoprene washers. Fasteners have integral hex washer heads shall have neoprene washers.

2.04 SHEET METAL ACCESSORIES

A. Steel accessories including louvers shall have a Factory Color Protective coating as specified here in before for panel and siding.

B. Ridge caps, eve and edge strips, facia strips, miscellaneous flashings, and miscellaneous sheet metal accessories, unless specified otherwise, shall be formed from the same material and gauge as the roof covering.

C. Wall plates, base angles, or base channels, and other miscellaneous framing members may be standard structural steel shapes may be formed from steel not lighter than 16 gauge.

D. Louvers and frames shall have sheet steel of minimum 18 gauge before forming and coating, or an equivalent strength of nonferrous metal.

E. Provide 18” x 14” or 18” x 16” mesh screening conforming to the Metal Building Manufacturers' Standard, in rewireable frames.

F. The screens and frames shall be of the same type of metal as the louvers.

2.05 MISCELLANEOUS ACCESSORIES

A. Closure strips shall be formed of approved solid synthetic or natural rubber material.

B. Molded closure strips shall be free of open voids and shall not absorb or retain water.

C. Joint sealing material of a type as recommended by the roofing and siding manufacturer shall be provided to seal all side and end laps in metal roofing of the deep corrugation type where the slope of the roof is less than 3 in 12 inches.

D. Door shall be "S" type "FG" as manufactured by Pioneer Industries with 1/4" misco wire glass, or equal type standard with the manufacturer.

1. All hardware for the complete installation of doors shall be provided.

2. Hardware shall include galvanized steel, interlocking butt hinges, cylindrical lock set, flashing, and positive weather seal.

PART 3 – EXECUTION

3.01 FRAMING

A. The building shall be erected at the location shown on the plans.

B. Templates or other gauging devices shall be used to assure accurate spacing of the expansion bolts.

C. Defects or errors in the fabrication of building components shall be corrected by the Contractor in an approved manner. Defects or errors in fabrication of components, which cannot be corrected in an approved manner, shall be replaced by non-defective members at no additional cost to the Owner.

D. All field connections shall be bolted, unless indicated or specified otherwise.

E. Steel frames shall be plumbed in both directions, bracing members shall be connected and all framing elements shall be accurately spaced to assure the proper fitting or prefabricated wall and roof coverings.

3.02 SHEETS AND PANELS

A. All sheets or panels shall be applied with the corrugations, ribs or other configurations in a vertical position.

B. All side and end laps shall be sealed with the joint sealing material specified herein before.

C. All walls shall be flashed and/or sealed at the base, at the top, around windows, doors, framed louvers, and all other similar openings.

D. The placement of closure strips, flashing and sealing materials shall be accomplished in an approved manner which will assure complete weather tightness.

E. Flashing will not be required where approved "self-flashing" sheets or panels are used.

F. Minimum end laps for all types of sheets or panels shall be 2 1/2 inches. Minimum side laps for all types of sheets or panels shall be full configuration.

G. All side and end laps shall be sealed as specified hereinbelow for roofing, except that only one bead of plastic cement will be required.

3.03 ROOF

A. Roof slope shall be as recommended by the manufacturer.

B. All roofing sheets or panels shall be applied with the corrugations, ribs or other configurations parallel to the slope of the roof.

C. The roofing sheets or panels shall be supplied in full lengths from ridge or ridge panel to eaves with no transverse joints except at the junction of ventilators, curbs, skylights, chimneys and similar openings.

D. All side laps shall be laid away from the prevailing wind, and all side and end laps shall be sealed with the joint sealing material specified herein before.

E. The roof shall be flashed and sealed at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary.

F. The placement of closure strips, flashing and sealing material shall be accomplished in an approved manner which will assure complete weather tightness.

G. All contact surfaces between roofing sheets at end and side laps shall be sealed with plastic cement, squeezed from a pressure gun and forming two beads, each not less than 1/4 inch.

3.04 LOUVERS AND FRAMES

A. Blades shall be folded or beaded at the edges, set at an angle which will exclude driving rains, and firmly secured to the frames by riveting or welding, whichever is standard with the manufacturer.

B. The screen frames shall be installed by means of clips in a manner which will permit them to be removed readily for cleaning and rewiring.

C. Louver frames shall be flashed and/or caulked to assure weather tightness where they abut the wall construction.

3.06 ACCESSORIES

A. Closure strips shall be formed to match the corrugations or configurations of the roofing or siding being used and shall be provided where necessary to provide weathertight construction.

B. The material shall be applied in accordance with the manufacturer's printed instructions. Sealing material shall be used also for sealing all joints in and around sealing strips at ridge, eaves, valleys, bottom course in sliding on vertical surfaces, bolt holes before inserting fasteners, for all flashings and corner closure sheets, and elsewhere as necessary to provide watertight construction. Bituminous type sealing materials shall not be used with factory color coated or painted sheets and panels.

END OF SECTION

SECTION 13610
WALKWAYS AND WORK PLATFORMS

PART 1 – GENERAL

1.01 SCOPE

A. The work for this section involves the furnishing and installing of walkways and work platform structures necessary for a complete installation in corrosive environments (e.g., wastewater treatment plants, pump stations, etc.).

1.02 SUBMITTAL OF INFORMATION

A. Submit manufacturers data showing:

1. Dimensions of structure

2. Materials of construction

3. Calculations of expected deflections of structure

B. Submit shop drawings showing the structure's installation, layout, and dimensions.

C. Submit Operation and Maintenance Manuals, which include specific instructions for receiving and handling, disassembly, installation repair and service, and a full parts list.

PART 2 – PRODUCTS

2.01 FLAT CHANNEL COVERS

A. The flat channel covers shall be at a minimum designed of 3/16" thick aluminum diamond tread plate. Fiberglass maybe used as an alternative with the project engineer's agreement. Alternate prefabricated aluminum cover systems such as the Thermacon Enviro Covertite system shall be acceptable.

B. Acceptable covers shall be of airtight and watertight construction.

C. Cover systems shall use gaskets between panels and channel edges to obtain a tight seal.

D. No caulking or any type of secondary sealant may be used.

E. Gaskets shall be Neoprene Mil R900 or equal.

F. Covers shall fit into the existing channel with no modification of the channel itself. The top of the cover shall be flush with the top of the channel with no exposed ridges protruding.

G. The covers shall be supported by a structural grid support system having the following properties:

1. Shall be able to withstand concentrated loads of at least 350 lbs. and uniform loads of at least 25 psf.

2. Shall have a deflection rate of L/240 or lower, where L is the overall cover length.

H. Covers must meet all O.S.H.A. regulations for walkways and work platforms.

I. Fiberglass covers must be able to resist the corrosion affects of UV lights.

J. Covers shall be removable by plant personnel without special lifting equipment.

K. All bolts and fasteners shall be type 316 stainless steel and comply with ASTM A167.

L. No more than six (6) bolts shall need to be removed to remove any panel within the cover system.

M. No more than two (2) other panels shall be disturbed when removing a single panel from any location.

N. Multiple covers shall not be allowed for any given span.

2.02 STAIRS AND PLATFORMS

A. Stairs and platforms shall be constructed of 1” minimum tubular aluminum frame.

B. The walking surface shall be constructed of 3/16” minimum aluminum plate. The aluminum plate shall have a reverse stamped pattern covering the entire work surface.

C. All joints and panels shall be welded in place according to the American Welding Society’s standard for aluminum.

D. The tubular frame and plate system shall be able to withstand concentrated loads of 500 lbs. and uniform loads of at least 30 psf. The system shall also have a minimum deflection rate of L/240, where L is the overall member or span length.

E All stairs and platforms shall strictly conform to all O.S.H.A. regulations for walkways and work platforms.

END OF SECTION

C. EQUIPMENT SPECIFICATIONS

SECTION 15100
VALVES

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. American Waterworks Association (AWWA):

C-500 Gate Valves-3" through 48" for Water and Other Liquids

B. American Society for Testing and Materials (ASTM):

A48 Gray Iron Casting

A240 Chromium and Chromium-Nickle Stainless Steel Plate Sheet, and Strip for Fusion-Welded Unifired Pressure Vessels

A307 Low Carbon Steel Externally and Internally Threaded Standard Fasteners

C. American National Standards Institute (ANSI):

B18.2 Square and Hex-Head Bolts and Screws

1.02 DESCRIPTION

A. All valves of the same type shall be from a single manufacturer. Parts for valves of the same type and size shall be interchangeable. Spare parts shall be furnished where required in the payment items. Special tools required for repacking or dissembling valves shall be provided.

B. All valves shall open left (counter-clockwise)

1.03 SUBMITTALS

A. The Contractor shall prepare and submit for approval, six (6) copies of complete detailed drawings of all valves.

PART 2 – PRODUCTS

2.01 VALVES

A. All valves 2" in diameter and smaller shall be constructed of brass or bronze except that the hand wheel which shall be of malleable iron construction with screwed ends. All valves 2-1/2" in diameter and larger shall have flanged ends for interior service and mechanical joints for buried service unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze.

B. Gate Valves:

1. Gate valves smaller than three inches shall meet the requirements of Fed. Spec. WW-V-54, Class A, 125 pounds.

2. Gate valves three inches and larger shall have nonrising stems and shall meet the requirements of AWWA Standard C-500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thickness and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 150 psi.

3. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze. The glands shall be bronze or bronze bushed. Gland bolts and nuts shall be bronze.

4. All gate valves 2-1/2 inches in diameter and larger shall be of the double disc type. All gate valves two inches in diameter and smaller shall be of the double disc or the solid wedge type.

5. Valves to have two inches square operating nut, with the exception that gate valves in altitude valves pits shall have hand wheels.

6. Valves buried in ground or located in vaults or structures shall have suitable extensions for socket operation with top of operating nut located six blow finished grades.

C. Check Valves:

1. Check valves 2" through 24" shall be iron body, bronze mounted swing check valves meeting the requirements of AWWA Standard C508-76.

2. The check valve shall be metal to metal or composite to metal seat construction with flange ends or screw and coupled ends.

D. Altitude Valves:

1. Altitude valves shall have bodies and bonnets of cast iron, or semi-steel with Bronze trim unless otherwise noted on the drawings. They shall be of the differential single acting type as designated on the drawings, and in general shall perform the service of maintaining the liquid level of the storage facility(s) to which they are attached within a 3" to 12" variation.

2. The valve must be cushioned by air or water in opening and closing to prevent hammer and shock. A regulating device shall be provided to adjust the speed of valve closing.

3. All altitude valves furnished for use on this project shall be equipped for showing at all times the position of the valve. Said altitude valves shall be of the size specified on the drawings and suitable for the use intended.

4. The Contractor shall supply the services of a qualified manufacturer's representative to check and calibrate each altitude valve installation for proper working pressure and sequence.

E. Air Release Valves

1. Air release valve shall have all bronze body and bonnet. They shall be the direct acting type.

2. Valves shall be hydrostatically tested to at least 150 psi.

3. The valve shall have stainless steel floats and an internal coating with rust inhibitors.

F. Automatic Control Valves

1. Automatic control valves shall be diaphragm actuated. Valve seat design should readily handle low flow and high differential flow, without enhancement devices.

2. Stainless steel main valve body stem shall be guided top and bottom. The ductile iron valve body shall be rated at 250 psi for class 150 flanges; 640 psi for class 300 flanges; and 640 psi for threaded connections.

3. Ductile iron body and body parts shall be ASTM A536 – epoxy coated. Main valve stem and pilot stems shall be AISI 303 stainless. Diaphragm shall be nylon reinforced Buna – N. Pilot bodies, seat ring and Y-strainer shall be B62 cast bronze. Studs, nuts, plugs and stems should be non-rusting.

4. Speed controls and isolation cocks shall be standard and shall be brass. All tubing shall be stainless and fittings can be a combination of brass and stainless. All valves shall have visual indicators and shall have up-stream and down-stream isolated pressure gauge ports in pilot system.

5. Basic valve port shall be full-port (line size – same as flanges), unless otherwise designated in the written specification. Basic valve and pilot components shall be machined and assembled in the United States.

6. Electric solenoids, utilized as part of the pilot system, shall be commercially distributed throughout the United States, have manual overrides, and they shall be full ported, tube line size, and not piloted in series with accelerators.

PART 3 – EXECUTION

A. All valves shall be carefully mounted in their respective positions free from distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project.

B. Valve box and cover shall be installed with each valve as shown in miscellaneous details.

C. Valves shall be delivered to customer with O&M manual and accompanied with electrical application wiring schematic where applicable.

END OF SECTION

IN-LINE PUMP STATION
FACTORY BUILT MOUNTED PUMP STATION
WITH TRIPLEX SELF-PRIMING PUMPS
(IN-LINE PUMP STATION)

PART 1 - GENERAL

1.01 Work under this section includes, but is not limited to, furnishing and installing a factory built triplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)

a.	ANSI B16.1	Cast iron pipe flanges and flanged fittings.
b.	ANSI/AWWA C115/A21.51	Cast/ductile iron pipe with threaded flanges.
c.	ANSI 253.1	Safety Color Code for Marking Physical Hazards.
d.	ANSI B40.1	Gages, Pressure and Vacuum.
e.	AWWA C508	Single Swing Check Valves.

2. American Society for Testing and Materials (ASTM)

a.	ASTM A48	Gray Iron Castings.
b.	ASTM A126	Valves, Flanges, and Pipe Fittings.
c.	ASTM A307	Carbon Steel Bolts and Studs.
d.	ASTM A36	Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)

a.	ANSI/IEEE Std 100	Standard Dictionary of Electrical Terms.
b.	ANSI/IEEE Std 112	Test Procedure for Polyphase Induction Motors.
c.	IEEE Std 242	Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)

a.	NEC	National Electric Code.
b.	NEC 701	National Electric Code article 701.
c.	NEMA Std MG1	Motors and Generators.

5. Miscellaneous References

a. Ten-State Standards Recommended Standards for Sewage Works.
b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
d. ISO 9001International Organization for Standardization.

1.03 SYSTEM DESCRIPTION

A. Contractor shall furnish and install one factory built base mounted, automatic pump station. Each pumping station shall be capable of carrying the peak demand. The station shall be complete with all equipment specified herein; factory assembled on a common steel base. All automatic stations shall be provided with automatic signaling apparatus which will report when the station is out of service.

B. Principal items of equipment shall include three (3) horizontal self-priming centrifugal sewage pumps, V-belt drives, motors, piping, valves, motor control panel, automatic liquid level control system, and integral wiring.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under *PART 2 - PRODUCTS* of this section.

1.04 PERFORMANCE CRITERIA

A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 10" suction connection, and 12" discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Total Average Flow (MGD)	1.0 MGD
2. Peak Flow (MGD)	2.0 MGD
3. Peak Hour Flow (MGD)	3.0 MGD
4. Total Dynamic Head (FT)	40
5. Maximum Static Head (FT)	32.9
6. Minimum Static Head (FT)	27.9

B. Site power furnished to pump station shall be 3 phase, 60 hertz, 480 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit 3 copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Contractor piping connections and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions.

b. Instructions for operating pumps and pump controls in all modes of operation.

c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations or require operating personnel to selectively read portions of the manual will not be approved. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.06 QUALITY ASSURANCE

A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the

engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

E. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an approved supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

F. Reprime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

3. Pump must reprime 22 vertical ft. at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

   a. A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90-degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

d. Impeller clearances shall be set as recommended in the pump service manual.

e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

f. Liquid to be used for reprime test shall be water. Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent either backpressure or back siphonage backflow.

4. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

G. Factory System Test

1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer’s facility.

H. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.07 MANUFACTURER'S WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

   1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are 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.

   2. 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.

B. 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.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer’s representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCT

2.01 UNITARY RESPONSIBILITY

A. 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.

2.02 MANUFACTURER

A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company or Americas Pioneer Pump or approved equal. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.03 UNIT BASE

A. The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating

conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

2.04 PUMP DESIGN

A. Three (3) pumps at 1 MGD shall be furnished in the pump station. Two (2) pumps shall be dual pumps at 2 MGD with the third as a spare pump.

B. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.

C. The manufacturer of the pumps must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

D. Materials and Construction Features

1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

2. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:

a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.

d. Two O-rings of Buna-N material shall seal coverplate to pump casing.

e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

a. Sealplate and bearing housing shall be cast iron Class 30. 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.

1) 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.

2) 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.

3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

d. 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. Pump designs which use the same oil to lubricate the bearings and shaft seal shall will not be approved.

e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium 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. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.

f. 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.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

a. 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., will not be approved. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the

pump. The removal of stainless-steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above.

c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance will not be approved.

5. 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 through the coverplate opening, without disturbing the suction piping. 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 approved.

6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or 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 equipment.

E. Serviceability

1. In-line booster pumps shall be accessible for servicing and repairs.

2. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

3. No special tools shall be required for replacement of any components within the pump.

4. The pumping units shall have spare parts and tools readily available.

F. Drain Kit

1. Pumps to be supplied with a drain kit for ease of maintenance. The kit to 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 gate valve and aluminum male quick connect fitting.

G. Spare Parts Kit

1. The following minimum spare parts shall be furnished with the pump station:

d. One spare pump mechanical seal (complete with shaft sleeve).
e. One cover plate O-Ring.
f. One rotating assembly O-Ring.
g. One set of impeller clearance adjustment shims.

2.05 VALVES AND PIPING

A. Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber face, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18 8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid will not be approved.

B. A plug valve must allow either or all pumps to be isolated from the force main. Valve shall pass 3" spherical solids. The plug valve shall be non lubricated, tapered type. Valve body shall be semi steel 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. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump 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. Valves shall provide visual indication of valve closure and shall operate solely on discharge pressure. Valves which require connection to the suction line will not be approved.

2. 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.

3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

D. Gauge Kit

1. Each pump shall have a standard pressure gauge on its discharge line, a compound gauge on its suction line, a means for measuring the discharge, sampling taps, a flow rate indicator, a totalizing meter, and a method of recording the total water pumped.

2. 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.

3. 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.

E. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

5. Piping shall be designed so that friction head will be minimized, not be subject to contamination, have watertight joints, be protected against surge or water hammer and provided with suitable restraints where necessary.

6. Each pump shall have an individual suction line, or the lines shall be manifolded that they will ensure hydraulic and operation conditions.

F. Water Seals

1. Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal shall:

a. Be provided with either an approved reduced pressure principle backflow preventer or a break tank open to atmospheric pressure; and

b. where a break tank is provided, have an air gap of at least six inches or two pipe diameters, whichever is greater, between the feeder line and the flood rim of the tank.

G. Supports and Thrust Blocks

1. Contractor must ensure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.06 DRIVE UNIT

A. Pump motors shall be 30 HP, horizontal inverter duty, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.

B. Drive Transmission

1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

2. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 will not be approved. Computation of safety factors shall be based on performance data published by the drive manufacturer.

3. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.

4. The pump manufacturer shall submit power transmission calculations which document the following:

    a. Ratio of pump/motor speed.
    b. Pitch diameter of driver and driven sheaves.
    c. Number of belts required per drive.
    d. Theoretical horsepower transmitted per belt, based on vendor's data.
    e. Center distance between pump and motor shafts.
    f. Arc-length correction factor applied to theoretical horsepower transmitted.
    g. Service factor applied to established design horsepower.
    h. Safety factor ratio of power transmitted/brake horsepower required.

5. Belt guards

    a. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.

    b. Guards must be completely removal without interference from any unit component, and shall be securely fastened and braced to the unit base.

    c. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.

    d. The guard shall be finished with one coat of gray W.R. non lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.07 FINISH

Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint

application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.08 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. Panel Enclosure

1. Electrical control equipment shall be mounted within a NEMA 4X stainless steel control enclosure with Air Conditioner. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.

2. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

C. 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 pad lockable 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. Variable frequency drives shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C
   a. Relative Humidity: Less than 95% non-condensing
   b. Altitude: Less than 1,000M (3300 ft) above sea level
   c. Vibration: .006 inches displacement, 1G peak
   d. Shock: 15G peak for 11mS (+/- 1.0mS)
   e. Control Specification
   f. Control System: Sinusoidal pulse width modulated voltage waveform
   g. Frequency Accuracy: +/- 0.4% of max. frequency
   h. Volts/Hertz Ratio: V/Hz user programmable
   i. Operation Frequency: 0 to 400 Hz
   j. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds

4. Digital Readout and Monitor

   a. 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.

5. Protection

a. 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.

6. The system protection will provide the following:

   a. Intermittent overload - 50 to 150%
   b. Current limit - 50 to 115%
   c. Overcurrent - 220-300% of rated output current
   d. Inverse time overload - 50 to 100%
   e. Short circuit - Phase to phase or phase to ground
   f. Overvoltage - 10% above input line or DC bus voltage
   g. Undervoltage - 10% below line voltage
   h. Power loss ride-through - 500Ms

7. 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:

   a. Overcurrent
   b. Short circuit
   c. Overload
   d. Overvoltage
   e. Undervoltage
   f. Overheat
   g. Ground fault
   h. Motor stalled
   i. Power supply fault

8. 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.

9. 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.

10. Operational Functions:

a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
b. Volts/Hertz patterns user selectable.
c. Maximum and minimum frequency limit adjustments.

D. Phase Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

E. Control Circuit

1. A normal duty thermal magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil tight design with contacts rated NEMA A300 minimum.

3. Control logic shall be accomplished using a programmable logic controller (PLC).

4. Electromechanical relays and timers shall be equipped with 120VAC coils and contacts rated Nema A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

5. Programmable controls shall operate on 120VAC power and be equipped with 120VAC inputs and hard contact outputs. Outputs shall have an inductive load rating equivalent to a size 4 contactor. Inputs shall incorporate a filter time delay and the overall controller noise immunity shall meet Nema standard ICS 2-230. The power supply to the programmable control shall include an active tracking filter protection system to minimize the effects of electrical noise.

6. Operator interface equipment shall be provided to permit field adjustment of the programmable control timers and counters and shall be mounted on the control panel with other operator controls and displays.

7. The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall be included to facilitate field repair or replacement of the programmable control hardware.

8. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.

9. The control shall be pre-programmed or wired to provide the following routines:

    a. Pump alternation at lead stop
    b. Excessive pump run time alternation (1-9999 minutes)
    c. Jump to idle pump/drive on lead failure
    d. Pump start delays after power restoration
    e. Flashing alarm/steady acknowledge on all alarm pilot lights
    f. Station trouble alarm (115vac and normally open dry contact)
    g. High and low level alarms
    h. Pump high temperature shutdown
    i. Motor high temperature

10. The control system shall be equipped with the following dry contacts wired to the terminal blocks:

    a. Pump run - (1) N.O. each pump
    b. Drive fault - (1) N.O. each pump
    c. High pump temperature shutdown - (1) N.O. each pump
    d. High motor temperature - (1) N.O. each pump
    e. Three phase voltage monitor - (1) N.C.
    f. High water alarm - (1) N.O.
    g. Low water alarm *(optional)*- (1) N.O.
    h. SCADA pump disable – (1) N.C. each pump
    i. Manual Pump Run – (1) N.O. each pump

11. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal magnetic circuit breaker.

12. Auxiliary Power Transformer

    a. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary

and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door, and 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.

13. Wiring

a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).

c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

i. Line and Load Circuits, AC or DC power..... Black
ii. AC Control Circuit Less Than Line Voltage..... Red
iii. DC Control Circuit..... Blue
iv. Interlock Control Circuit from external source..... Yellow
v. Equipment Grounding Conductor..... Green
vi. Current Carrying Ground..... White
vii. Hot With Circuit Breaker Open..... Orange

d. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

e. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

f. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

14. Conduit

a. Factory installed conduit shall conform to following requirements:

i. All conduit and fittings to be UL listed.
ii. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
iii. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
iv. Conduit shall be sized according to the National electric Code.

15. Grounding

a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

16. Equipment Marking

a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

i. Equipment serial number
ii. Control panel short circuit rating
iii. Supply voltage, phase and frequency
iv. Current rating of the minimum main conductor
v. Electrical wiring diagram number
vi. Motor horsepower and full load current

vii. Motor overload heater element
viii. Motor circuit breaker trip current rating
ix. Name and location of equipment manufacturer

b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.09 LIQUID LEVEL CONTROL

A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. Submersible Transducer System

1. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0 12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 0-5Vdc or 4-20mA. The transducer's polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

2. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

2.10 BACK UP LIQUID LEVEL CONTROL (Float Switch Type)

A. The level control system shall start and stop pump motors in response to changes in wet well level. It shall be the non-mercury float switch type with floats to be secured to a vertical pipe in the wet well. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.

B. The level control system shall start and stop the pumps in accordance to the wet well level. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the "lead pump start level". When the water is lowered to the "lead pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the water continue to rise, an additional float switch will start the second pump after reaching the "lag pump start level" so that two pumps operate together. All pumps shall stop at the same "all pumps off level". Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit will not be approved.

C. The level control system shall work in conjunction with a PLC to select first one pump, then the second pump, then the third pump, to run as "Lead" pump. Alternation will occur at the end of each pumping cycle.

D. Float switches shall be supplied for installation by the contractor. Each float shall contain a non-mercury switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. A PVC or stainless-steel mounting pipe shall be furnished by the contractor to secure the switches in the wet well.

E. A junction box shall be supplied for installation in the wet well by the contractor. Junction box shall be NEMA 4X, non-corrosive type incorporating terminal blocks match-marked to terminals in the control panel.

F. A separate float switch and relay shall be used to alert maintenance personnel to a high water level in the wet well (low level float switch is optional). Should the water level rise to the "high water alarm" level, the float switch shall energize a 115 volt AC circuit for an external alarm device. An indicator, visible from front of control panel, shall indicate

high level condition exists. The alarm signal shall be maintained until wet well level is lowered and alarm circuit manually reset.

G. An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the alarm signal shall provide automatic reset of the alarm silence relay.

2.11 PUMPING FACILITIES

A. Pumping facilities shall be designed to maintain the sanitary quality of pumped water.

B. Pump stations normally associated with surface water sources, either as raw or finished water pump stations shall be of durable character, fire and weather resistant and with outward opening doors and have underground structure waterproofed

C. Stairways or ladder shall have handrails on both sides and treads of non-slip material, and stairs shall have risers not exceeding 9 inches and treads wide enough for safety.

D. Pump facilities shall be provided with crane-ways, hoist beams, eye bolts or other adequate facilities for servicing or removal of pumps, meters or heavy equipment, openings in floors, roofs or wherever else needed for removal of heavy or bulky equipment, and a convenient tool board or other facilities as needed for proper maintenance of the equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer’s representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer’s Start-up Services

1. Co-ordinate station start-up with manufacturer’s technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of

defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.04 PUMPING FACILITIES

A. Provision shall be made for adequate heating for the comfort of the operator, the safe and efficient operation of the equipment, and, in pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process and to allow proper operation of equipment and treatment processes.

B. Adequate ventilation shall be provided for all pumping stations for operator comfort and dissipation of excess heat from the equipment. Ventilation shall conform to relevant state and/or local codes. Forced ventilation of at least 6 changes of air per hour shall be provided for:

   a. all confined rooms, compartments, pits and other enclosures below grade floor; and

   b. any area where unsafe atmosphere may develop or where excessive heat may be built up.

C. In areas where excess moisture could cause hazards for operator safety or damage to equipment means for dehumidification shall be provided.

D. Pump stations shall be adequately lighted to deter vandalism and facilitate maintenance. All electrical work shall conform to the requirements of the related agencies and to relevant State and/or local codes.

E. Pumping stations which are manned for extended periods shall be provided with potable water, lavatory and toilet facilities. Plumbing must be so installed as to prevent contamination of a public water supply.

3.05 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap, and debris.

3.06 PROTECTION

A. The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

END OF SECTION

INFLUENT PUMP STATION
FACTORY-BUILT BASE MOUNTED PUMP STATION
WITH TRIPLEX SELF-PRIMING PUMPS
(INFLUENT PUMP STATION)

PART 1 - GENERAL

1.01 Work under this section includes, but is not limited to, furnishing and installing a factory built triplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

1.02 REFERENCES

A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
   a. ANSI B16.1 — Cast iron pipe flanges and flanged fittings.
   b. ANSI/AWWA C115/A21.51 — Cast/ductile iron pipe with threaded flanges.
   c. ANSI 253.1 — Safety Color Code for Marking Physical Hazards.
   d. ANSI B40.1 — Gages, Pressure and Vacuum.
   e. AWWA C508 — Single Swing Check Valves.

2. American Society for Testing and Materials (ASTM)
   a. ASTM A48 — Gray Iron Castings.
   b. ASTM A126 — Valves, Flanges, and Pipe Fittings.
   c. ASTM A307 — Carbon Steel Bolts and Studs.
   d. ASTM A36 — Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)
   a. ANSI/IEEE Std 100 — Standard Dictionary of Electrical Terms.
   b. ANSI/IEEE Std 112 — Test Procedure for Polyphase Induction Motors.
   c. IEEE Std 242 — Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
   a. NEC — National Electric Code.
   b. NEC 701 — National Electric Code article 701.
   c. NEMA Std MG1 — Motors and Generators.

5. Miscellaneous References

a. Ten-State Standards Recommended Standards for Sewage Works.
b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
d. ISO 9001International Organization for Standardization.

1.03 SYSTEM DESCRIPTION

A. Contractor shall furnish and install one factory built base mounted, automatic pump station. Each pumping station shall be capable of carrying the peak demand. The station shall be complete with all equipment specified herein; factory assembled on a common steel base. All automatic stations shall be provided with automatic signaling apparatus which will report when the station is out of service.

B. Principal items of equipment shall include four (4) horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, piping, valves, motor control panel, automatic liquid level control system, and integral wiring.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under *PART 2 - PRODUCTS* of this section.

1.04 PERFORMANCE CRITERIA

A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 10" suction connection, and 12" discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Total Average Flow (MGD)	1.0 MGD
2. Peak Flow (MGD)	2.0 MGD
3. Peak Hour Flow (MGD)	3.0 MGD
4. Total Dynamic Head (FT)	33
5. Maximum Static Head (FT)	24.4
6. Minimum Static Head (FT)	17.4

B. Site power furnished to pump station shall be 3 phase, 60 hertz, 480 volts, maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 SUBMITTALS

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit 3 copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Contractor piping connections and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

C. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions.

b. Instructions for operating pumps and pump controls in all modes of operation.

c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual will not be approved. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.06 QUALITY ASSURANCE

A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. All internal passages, impeller vanes, and recirculation ports shall pass a 3" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the

engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

E. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an approved supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

F. Reprime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

3. Pump must reprime 17 vertical ft. at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

   a. A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90-degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

d. Impeller clearances shall be set as recommended in the pump service manual.

e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

f. Liquid to be used for reprime test shall be water. Prime water must not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent either backpressure or back siphonage backflow.

4. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

G. Factory System Test

1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer’s facility.

H. The manufacturer’s technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.07 MANUFACTURER'S WARRANTY

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

   1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are 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.

   2. 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.

B. 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.

C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer’s representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCT

2.01 UNITARY RESPONSIBILITY

A. 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.

2.02 MANUFACTURER

A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company or Americas Pioneer Pump or approved equal. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

D. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

E. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.03 UNIT BASE

A. The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

2.04 PUMP DESIGN

A. Four (3) pumps at 1 MGD shall be furnished in this pump station. Two (2) pumps shall be dual pumps at 2 MGD with one (1) acting as a spare pump.

B. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.

C. The manufacturer of the pumps must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

D. Materials and Construction Features

1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

2. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:

   a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

   b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

   c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.

   d. Two O-rings of Buna-N material shall seal coverplate to pump casing.

   e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

   f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

   a. Sealplate and bearing housing shall be cast iron Class 30. 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.

      1) 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.

      2) 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.

3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

d. 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. Pump designs which use the same oil to lubricate the bearings and shaft seal shall will not be approved.

e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium 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. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.

f. 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.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

a. 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.,

will not be approved. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless-steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above

c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance will not be approved

5. 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 through the coverplate opening, without disturbing the suction piping. 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 approved.

6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or 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 equipment.

E. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the pump.

3. The pumping units shall have spare parts and tools readily available.

F. Drain Kit

1. Pumps to be supplied with a drain kit for ease of maintenance. The kit to 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 gate valve and aluminum male quick connect fitting.

G. Spare Parts Kit

1. The following minimum spare parts shall be furnished with the pump station:

d. One spare pump mechanical seal (complete with shaft sleeve).
e. One cover plate O-Ring.
f. One rotating assembly O-Ring.
g. One set of impeller clearance adjustment shims.

2.05 VALVES AND PIPING

A. Each pump shall be equipped with a positive acting, full flow type check valve on the discharge side between the pump and shutoff valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber face, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18 8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid will not be approved.

B. A plug valve must allow either or all pumps to be isolated from the force main. Valve shall pass 3" spherical solids. The plug valve shall be non lubricated, tapered type. Valve body shall be semi steel 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. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump 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. Valves shall provide visual indication of valve closure and shall operate solely on discharge pressure. Valves which require connection to the suction line will not be approved.

2. 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.

3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

D. Gauge Kit

1. Each pump shall have a standard pressure gauge on its discharge line, a compound gauge on its suction line, a means for measuring the discharge, sampling taps, a flow rate indicator, a totalizing meter, and a method of recording the total water pumped.

2. 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 graduate -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.

3. 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.

E. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

5. Piping shall be designed so that friction head will be minimized, not be subject to contamination, have watertight joints, be protected against surge or water hammer and provided with suitable restraints where necessary.

6. Each pump shall have an individual suction line, or the lines shall be manifolded that they will ensure hydraulic and operation conditions.

F. Water Seals

1. Water seals shall not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal shall:

   a. Be provided with either an approved reduced pressure principle backflow preventer or a break tank open to atmospheric pressure; and

   b. where a break tank is provided, have an air gap of at least six inches or two pipe diameters, whichever is greater, between the feeder line and the flood rim of the tank.

G. Supports and Thrust Blocks

1. Contractor must ensure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.06 DRIVE UNIT

A. Pump motors shall be 25 HP, horizontal inverter duty, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.

B. Drive Transmission

1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

2. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 will not be approved. Computation of safety factors shall be based on performance data published by the drive manufacturer.

3. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.

4. The pump manufacturer shall submit power transmission calculations which document the following:

    a. Ratio of pump/motor speed.
    b. Pitch diameter of driver and driven sheaves.
    c. Number of belts required per drive.
    d. Theoretical horsepower transmitted per belt, based on vendor's data.
    e. Center distance between pump and motor shafts.
    f. Arc-length correction factor applied to theoretical horsepower transmitted.
    g. Service factor applied to established design horsepower.
    h. Safety factor ratio of power transmitted/brake horsepower required.

5. Belt guards

    a. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.

    b. Guards must be completely removal without interference from any unit component, and shall be securely fastened and braced to the unit base.

    c. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.

    d. The guard shall be finished with one coat of gray W.R. non lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.07 FINISH

A. Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polymide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

2.08 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. Panel Enclosure

1. Electrical control equipment shall be mounted within a NEMA 4X stainless steel control enclosure with Air Conditioner. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.

2. All control devices and instruments shall be secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount and component. All control devices shall be clearly labeled to indicate function.

C. 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 pad lockable 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. Variable frequency drives shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C
   a. Relative Humidity: Less than 95% non-condensing
   b. Altitude: Less than 1,000M (3300 ft) above sea level
   c. Vibration: .006 inches displacement, 1G peak
   d. Shock: 15G peak for 11mS (+/- 1.0mS)
   e. Control Specification
   f. Control System: Sinusoidal pulse width modulated voltage waveform
   g. Frequency Accuracy: +/- 0.4% of max. frequency
   h. Volts/Hertz Ratio: V/Hz user programmable
   i. Operation Frequency: 0 to 400 Hz
   j. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds

4. Digital Readout and Monitor

   a. 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.

5. Protection

   a. 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.

6. The system protection will provide the following:

   a. Intermittent overload - 50 to 150%
   b. Current limit - 50 to 115%
   c. Overcurrent - 220-300% of rated output current
   d. Inverse time overload - 50 to 100%
   e. Short circuit - Phase to phase or phase to ground
   f. Overvoltage - 10% above input line or DC bus voltage
   g. Undervoltage - 10% below line voltage
   h. Power loss ride-through - 500Ms

7. 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:

   a. Overcurrent
   b. Short circuit
   c. Overload
   d. Overvoltage
   e. Undervoltage
   f. Overheat
   g. Ground fault
   h. Motor stalled
   i. Power supply fault

8. 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.

9. 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.

10. Operational Functions:

    a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
    b. Volts/Hertz patterns user selectable.
    c. Maximum and minimum frequency limit adjustments.

D. Phase Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

E. Control Circuit

1. A normal duty thermal magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be oil tight design with contacts rated NEMA A300 minimum.

3. Control logic shall be accomplished using a programmable logic controller (PLC).

4. Electromechanical relays and timers shall be equipped with 120VAC coils and contacts rated Nema A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

5. Programmable controls shall operate on 120VAC power and be equipped with 120VAC inputs and hard contact outputs. Outputs shall have an inductive load rating equivalent to a size 4 contactor. Inputs shall incorporate a filter time delay and the overall controller noise immunity shall meet Nema standard ICS 2-230. The power supply to the programmable control shall include an active tracking filter protection system to minimize the effects of electrical noise.

6. Operator interface equipment shall be provided to permit field adjustment of the programmable control timers and counters and shall be mounted on the control panel with other operator controls and displays.

7. The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall be included to facilitate field repair or replacement of the programmable control hardware.

8. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.

9. The control shall be pre-programmed or wired to provide the following routines:

    a. Pump alternation at lead stop
    b. Excessive pump run time alternation (1-9999 minutes)
    c. Jump to idle pump/drive on lead failure
    d. Pump start delays after power restoration
    e. Flashing alarm/steady acknowledge on all alarm pilot lights
    f. Station trouble alarm (115vac and normally open dry contact)
    g. High and low level alarms
    h. Pump high temperature shutdown
    i. Motor high temperature

10. The control system shall be equipped with the following dry contacts wired to the terminal blocks:

    a. Pump run - (1) N.O. each pump
    b. Drive fault - (1) N.O. each pump
    c. High pump temperature shutdown - (1) N.O. each pump
    d. High motor temperature - (1) N.O. each pump
    e. Three phase voltage monitor - (1) N.C.
    f. High water alarm - (1) N.O.
    g. Low water alarm (optional)- (1) N.O.
    h. SCADA pump disable – (1) N.C. each pump
    i. Manual Pump Run – (1) N.O. each pump

11. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal magnetic circuit breaker.

12. Auxiliary Power Transformer

a. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door, and 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.

13. Wiring

a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).

c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

i. Line and Load Circuits, AC or DC power..... Black
ii. AC Control Circuit Less Than Line Voltage..... Red
iii. DC Control Circuit..... Blue
iv. Interlock Control Circuit from external source..... Yellow
v. Equipment Grounding Conductor..... Green
vi. Current Carrying Ground..... White
vii. Hot With Circuit Breaker Open..... Orange

d. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

e. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires must be clearly numbered at each end in conformance with applicable standards. All wire

connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.

f. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

14. Conduit

a. Factory installed conduit shall conform to following requirements:

i. All conduit and fittings to be UL listed.
ii. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
iii. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
iv. Conduit shall be sized according to the National electric Code.

15. Grounding

a. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

b. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

16. Equipment Marking

a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

i. Equipment serial number
ii. Control panel short circuit rating
iii. Supply voltage, phase and frequency
iv. Current rating of the minimum main conductor

v. Electrical wiring diagram number
vi. Motor horsepower and full load current
vii. Motor overload heater element
viii. Motor circuit breaker trip current rating
ix. Name and location of equipment manufacturer

b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.09 LIQUID LEVEL CONTROL

A. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

C. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.

D. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.

E. Submersible Transducer System

1. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0 12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 0-5Vdc or 4-20mA. The transducer's

polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

2. An intrinsically safe repeater shall be supplied in the control enclosure. Repeater must be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from repeater to feeder lines and motor controls. Installing contractor shall make connections from repeater to transducer.

2.10 BACK UP LIQUID LEVEL CONTROL (Float Switch Type)

A. The level control system shall start and stop pump motors in response to changes in wet well level. It shall be the non-mercury float switch type with floats to be secured to a vertical pipe in the wet well. Rising and falling liquid level in the wet well causes switches within the floats to open and close, providing start and stop signals to the remainder of the level control system.

B. The level control system shall start and stop the pumps in accordance to the wet well level. Upon operator selection of automatic operation, a float switch shall start one pump motor when water rises to the "lead pump start level". When the water is lowered to the "lead pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the water continue to rise, an additional float switch will start the second pump after reaching the "lag pump start level" so that two pumps operate together. All pumps shall stop at the same "all pumps off level". Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit will not be approved.

C. The level control system shall work in conjunction with a PLC to select first one pump, then the second pump, then the third pump, to run as "Lead" pump. Alternation will occur at the end of each pumping cycle.

D. Float switches shall be supplied for installation by the contractor. Each float shall contain a non-mercury switch sealed in a polypropylene housing, with 30 feet of power cord, and polypropylene mounting hardware. A PVC or stainless-steel mounting pipe shall be furnished by the contractor to secure the switches in the wet well.

E. A junction box shall be supplied for installation in the wet well by the contractor. Junction box shall be NEMA 4X, non-corrosive type incorporating terminal blocks match-marked to terminals in the control panel.

F. A separate float switch and relay shall be used to alert maintenance personnel to a high water level in the wet well (low level float switch is optional). Should the water level rise

to the "high water alarm" level, the float switch shall energize a 115 volt AC circuit for an external alarm device. An indicator, visible from front of control panel, shall indicate high level condition exists. The alarm signal shall be maintained until wet well level is lowered and alarm circuit manually reset.

G. An alarm silence switch and relay shall provide maintenance personnel a means to de-energize the external alarm device while corrective actions are under way. After silencing the alarm, manual reset of the alarm signal shall provide automatic reset of the alarm silence relay.

2.11 PUMPING FACILITIES

A. Pumping facilities shall be designed to maintain the sanitary quality of pumped water.

B. Pump stations normally associated with surface water sources, either as raw or finished water pump stations shall be of durable character, fire and weather resistant and with outward opening doors and have underground structure waterproofed

C. Stairways or ladder shall have handrails on both sides and treads of non-slip material, and stairs shall have risers not exceeding 9 inches and treads wide enough for safety.

D. Pump facilities shall be provided with crane-ways, hoist beams, eye bolts or other adequate facilities for servicing or removal of pumps, meters or heavy equipment, openings in floors, roofs or wherever else needed for removal of heavy or bulky equipment, and a convenient tool board or other facilities as needed for proper maintenance of the equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer’s representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

A. Manufacturer’s Start-up Services

1. Co-ordinate station start-up with manufacturer’s technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of

defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

3.04 PUMPING FACILITIES

A. Provision shall be made for adequate heating for the comfort of the operator, the safe and efficient operation of the equipment, and, in pump houses not occupied by personnel, only enough heat need be provided to prevent freezing of equipment or treatment process and to allow proper operation of equipment and treatment processes.

B. Adequate ventilation shall be provided for all pumping stations for operator comfort and dissipation of excess heat from the equipment. Ventilation shall conform to relevant state and/or local codes. Forced ventilation of at least 6 changes of air per hour shall be provided for:

C. All confined rooms, compartments, pits and other enclosures below grade floor; and

D. Any area where unsafe atmosphere may develop or where excessive heat may be built up.

E. In areas where excess moisture could cause hazards for operator safety or damage to equipment means for dehumidification shall be provided.

F. Pump stations shall be adequately lighted to deter vandalism and facilitate maintenance. All electrical work shall conform to the requirements of the related agencies and to relevant State and/or local codes.

G. Pumping stations which are manned for extended periods shall be provided with potable water, lavatory and toilet facilities. Plumbing must be so installed as to prevent contamination of a public water supply.

3.05 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap, and debris.

3.06 PROTECTION

A. The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture.

END OF SECTION

SECTION 15215
RECLAIMED WATER PUMP STATION

PART 1 - GENERAL

1.01 SCOPE

A. The work of this section involves furnishing and installing one (1) mounted pump station complete with hydropneumatics tank and controls, access covers and accessories necessary for a complete installation. Controls shall be as specified in paragraph 2.03, below. The contractor shall furnish and install one factory-built, automatic pumping station as manufactured by Gorman-Rupp Co., Mansfield, Ohio, or approved equal. The station shall be complete with all the necessary equipment, factory-installed on a welded steel base.

B. The principal items of equipment shall include two (2) vertical, close-coupled, motor driven, vacuum primed, two-port impeller type non-clog Turbo pumps; valves; internal piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.

C. The controls shall start the pump when the pressure in the tank drops below 40 psi and stop the pump when the pressure reaches 60 psi or the water level reaches a preset water level.

1.02 SUBMITTAL OF INFORMATION

A. Submit characteristic curves for pumps, showing total dynamic head, efficiency and brake horsepower plotted against capacity in gpm for all conditions of head and capacity.

B. Submit manufacturers data showing dimensional information and materials of construction for pumps, discharge elbows, access covers, control panels, floats, and all other accessories. Control panel drawings shall include wiring diagrams.

C. Submit shop drawings showing equipment installation, layout, and dimensions.

D. Submit Operation and Maintenance Manuals, which include specific instructions for receiving and handling, disassembly, wiring, installation repair and service troubleshooting pumps and controls, and full parts list.

PART 2 - PRODUCTS

2.01 PUMPS

A. Quantity of Pumps: 2

B. Manufacturer: Gorman-Rupp model CG2D3-B or approved equal

C. Operating Conditions:

1.	Capacity (GPM):	60 GPM
2.	Max. Static Lift (ft):	35’
3.	Total Dynamic Head (ft):	230’
4.	Min. Motor Power (hp):	10 HP
5.	Speed (RPM):	3450 RPM
6.	Liquid Type:	Clean Water

D. All openings and passages shall be large enough to permit the passage of a sphere 3” in diameter. The pump motors shall not be overloaded beyond their nameplate rating at the design conditions nor at any head in the operating range.

The pumps shall be centrifugal, non-clog two-port impeller type of single vane enclosed ductile iron construction. In order to minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing.

The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move in a linear direction with the thermal expansion of the shaft and shall carry only radial loads.

The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

The pump impeller shall be of the enclosed type made of close-grained cast iron and shall be balanced. The impeller shall be keyed with a stainless-steel key and secured to the motor shaft by a stainless-steel cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter shall be trimmed inside the impeller shrouds. The shrouds shall remain full diameter so that close minimum clearance from shrouds to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

The pump shall be constructed so as to permit priming from the lower pressure area behind the impeller. Priming from high-pressure connections, which tends to cause solids to enter and clog the priming system, will not be acceptable. The priming bowl shall be transparent, enabling the operator to monitor the priming level.

The pump shall be arranged so that the rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead, or seal, so that any foreign object may be removed from the pump or suction line.

The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime in order to

allow both the pump and the seal to be drained, thereby preventing freezing and breakage for the seal during power outages in sub-freezing temperatures.

The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless-steel spring.

The pump volute shall be furnished with mounting lugs and bolted to the station floor plate, forming a gas-tight seal.

E. Materials of Construction:

The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet well as detailed in the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel with reinforcing, as required, to prevent deflection and ensure an absolutely rigid support.

The pump station shall be enclosed by a hatch cover. The cover shall have a suitable drip-lip around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock.

The cover shall have a latch mechanism to keep the cover open under load. Adjustable ventilating louvers shall be provided on each end of the fiberglass cover which are capable of being closed during cold weather operation.

An aluminum manway cover, located exterior to the fiberglass pump chamber, shall be provided, complete with padlocking provisions. The manway shall be an integral part of the station floor plate and provide access to the wet well.

A stanchion with lifting arm shall be provided to lift each pump. The lifting arm shall have a hook over the center of the motor to support a hoist (provided by others) for removal of the motors, impellers, and pumps from the station.

The pump volutes and discharge piping shall be mounted in relation to the floor plate as detailed in the construction drawings.

F. Welding:

All steel structural members shall be joined by electric arc welding with welds of adequate section for the joint involved.

G. Protection Against Corrosion:

All structural steel surfaces shall be factory blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of Versapox shall be factory applied. The coating shall be formulated for abrasion and corrosion resistance.

Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components such

as the electrical enclosure, ventilating blower and vacuum pumps shall be furnished with the original manufacturer's coating.

Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of the specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

H. Motors:

The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type, suitable for 3 phase, 60 Hz cycle, 460 volt electric current. They shall have Class F insulation. Insulation temperature shall, however, be limited to Class B. The motors shall have normal starting torque and low-starting torque and low-starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be terminated in a cast connection box and shall be clearly identified.

The motors shall have 1.15 service factor. The service factor shall be reserved for the owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design conditions, nor at any head in the operating range as specified under Operating Conditions.

The motor-pump shaft shall be centered, in relation to the motor base, within .005". The shaft runout shall not exceed .003".

The motor shaft shall equal or exceed the diameter specified under Main Pumps at all points from immediately below the top bearing to the top of the impeller hub.

A bearing cap shall be provided to hold the bottom motor bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.

2.02 PNEUMATIC TANK

A. Tank shall be a 600-gallon tank designed in accordance with ASME Boiler and Pressure Code.

B. The tank shall be capable of operating on a 70-psi internal pressure.

C. Tank shall be equipped with a pressure relief valve set at 65 psi, and a 6" dial, 0 to 80 psi pressure gauge.

D. Tank shall have an integrated valve to maintain the proper charge of air in the tank.

E. Tank shall bear a plate showing manufacturer, manufactured date, pressure rating, and capacity.

F. All surfaces must be coated with epoxy, and shall applied by the manufacturer and certified to be in full compliance with applicable sections of AWWA D100.

2.03 CONTROL PANELS

A. Power Distribution:

The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at a minimum of 90 degrees C. All conductor terminations shall be as recommended by the device manufacturer.

B. Transformers:

Control transformers shall provide the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. One leg of the secondary shall be grounded. The 120V control transformer shall have additional 100VA capacity for owners 120V miscellaneous electrical loads.

C. Phase Monitor:

A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reversed phasing and loss of a phase. Control circuits shall be de-energized upon sensing any of the faults and shall automatically restore service upon return to normal power.

D. Alarm System:

The alarm light shall be a weatherproof, shatterproof, red-light fixture with a 40 watt bulb to indicate alarm conditions. The alarm light shall be turned on by the alarm condition.

The alarm horn shall be mounted on the exterior of the cabinet. The alarm horn shall provide an aural signal of not less than 90db at 10 feet.

An alarm silence switch shall deactivate the alarm horn; however, the alarm light shall flash until the alarm condition ceases to exist. Provide a high-level alarm relay contact for Owner's remote alarm via telemetering system.

E. Control System:

The control equipment shall be mounted in a NEMA Type 4X steel enclosure with a removable access cover. The circuit breakers, starter-reset buttons, and control switches shall be operable without removing the access cover, for deadfront operation.

A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 120-volt AC devices. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.
Magnetic across-the line starters with under-voltage release and overload coils for each phase shall be provided for each pump motor to give positive protection.

Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker or shall be impedance protected. All switches shall be labeled, and a coded wiring diagram shall be provided.

To control the operation of the pumps with variations for liquid level in the wet well, a minimum of five (3) displacement switches shall be provided. A 20' cord shall be provided with each switch. The cord shall have a corrosion-resistant vinyl jacket and be multi-stranded in order to prevent fatigue.

An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps every eight hours. Alternating the pumps at less than eight-hour intervals will not be acceptable.

Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the low-level pump.

The pump control panel shall provide the following functions.

1. Pressure switch that allows to maintain the pressure on the system.

2. Provide six-digit non-settable elapsed time meters for indication of pump run times.

3. The duplex controller shall be a UL listed, plug-in, programmed, solid state unit. The controller shall include the following listed functions:

    a. Alternator
    b. Hand-off-Auto (HOA) switches
    c. Time delay relays
    d. Alternator selector switch
    e. Float indicating LED's
    f. Output LED's
    g. Alternator test switch

F. Main Piping:

The pump suction shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction riser. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed with an adjustable Teflon seal. An operating wrench shall be provided for the plug valves.

Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump casings or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor

plate at the factory so that field connections can be made without disturbing the gas-tight seals.

The manufacturer of the pump station shall provide a compression-type sleeve coupling for installation in the common discharge pipe.

G. Factory Tests:

All component of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts, and power factor; speed indicator; and a vibrometer capable of measuring both amplitude and frequency.

H. Spare Parts:

A complete replacement pump shaft seal assembly shall be furnished with each pump station. The spare seal shall be packed in a suitable container and shall include complete installation instructions. A spare casing and seal gasket shall be provided.

I. Installation and Operation Instructions:

Installation of the pumps and the hydropneumatics tank shall be done in accordance with the written instructions provided by the manufacturer. Operation and maintenance manuals shall be furnished which will include parts lists of components and complete service procedures and troubleshooting guide.

J. Startup:

The Manufacturer shall provide the services of a factory-trained representative for a maximum period of one day on-site to perform initial start-up of the pump station and to instruct the owner's operating personnel in the operation and maintenance of the equipment.

All AC inputs and outputs shall be protected against transients induced by inducted loads. The controller shall be UL listed as a control device with an intrinsically safe output level of 630 microwatts at 5 VDC applied to the float regulators assuring adherence to UL913 Publication for Division 1, Class 1, Intrinsically Safe Apparatus.

K. Miscellaneous:

4. Drawings: A final as built drawing encapsulated in mylar shall be attached to the inside of the front door. A list of all legends shall be included.

5. Panel Markings: All component parts in the control panel shall be permanently marked and identified as they are indicated on the drawing. Marking shall be

on the back plate adjacent to the component. All control conductors shall be identified with wire markers as close as practical to each end of conductors.

6. Testing: All panels shall be tested to the power requirements as shown on the plans to ensure proper operation of all the components. Each control function shall be activated to check for proper operation and indication.

7. Guarantee: All equipment shall be guaranteed for a period of one (1) year from the date of acceptance. The guarantee shall be effective against all defects in workmanship or defective components. The warranty is limited to replacement or repair of defective equipment.

8. Manufacturer: The manufacturer shall be a UL listed shop for industrial control systems and shall provide evidence of such on request from the Engineer or using authority.

END OF SECTION

SECTION 15280
CHEMICAL FEED SYSTEM
20% SODA ASH (Na_2CO_3), 49% ALUM (POTASSUM ALUM)

PART 1 - GENERAL

1.01 GENERAL

A. The work described in this section consists of furnishing and installing a complete chemical feed system for the 20% Soda Ash and 49% Alum feed system. The chemical feed system shall be approved by the engineer prior to purchase. Work shall include, but not be limited to, furnishing and installing all piping, chemical feed tanks, pumps, controls and appurtenances, heat tracing, all trenching, excavation and backfill, installing all concrete structures and complete surface restoration and cleanup.

1.02 SUBMITTALS

A. Six copies of manufacturer's drawings and catalog cuts of the following items shall be submitted for approval by the Engineer:

1. Duplex Chemical Feed Package
2. Chemical feed controls
3. Chemical storage tanks
4. Pipe and appurtenance
5. Heat Tracing

1.03 GENERAL EQUIPMENT DESIGN AND CAPACITY

General equipment design shall be such that:

1. Feeders will be able to supply, at all times, the necessary amounts of chemicals at an accurate rate, throughout the range of feed.
2. Feeders are adjustable to handle all plant flow rates.
3. Chemical-contact materials and surfaces are resistant to the aggressiveness of the chemical solution.

4. Corrosive chemicals are introduced in such a manner as to minimize potential for corrosion.

5. Chemicals that are incompatible are not stored or handled together.

6. All chemicals are conducted from the feeder to the point of application in separate conduits.

7. Chemical feeders are as near as practical to the feed point.

8. Chemicals are fed by gravity where practical and shall not be siphoned into the water supply.

9. Service water supply shall be protected from contamination by the chemical solutions. It should be equipped with backflow prevention devices, or an air gas should be provided between the supply line and the solution tank.

10. No direct connection shall exist between any sewer and drain or overflow from the feeder or solution chamber or tank. All drains shall terminate at least six inches or two pipe diameters, whichever is greater, above the overflow rim of a receiving sump, conduit or waste receptacle.

11. Positive Displacement Solution Pumps shall be used to feed liquid chemicals but shall not be used to feed chemical slurries. Pumps must be sized to match or exceed maximum head conditions found at the point of injection.

12. Calibration tubes or mass flow monitors which allow for direct physical measurement of actual feed rates should be provided.

13. A pressure relief valve should be provided on the pump discharge line; and

14. Liquid Chemical Feeders shall be such that chemical solutions cannot be siphoned into the water supply, by assuring discharge at a point of positive pressure, or providing vacuum relief, or providing a suitable air gap, or other suitable means or combinations as necessary.

PART 2 – PRODUCTS

2.01 DUPLEX CHEMICAL FEED PACKAGE

A. Duplex Chemical Feed Package shall be furnished as manufactured by ProMinent, USFilter/Wallace & Tiernan Encore 700 or approved equal.

B. The chemical feed pumps shall have a capacity range of 0.96GPM-25GPM

C. The pumps shall be self priming capable of suction lifts, when dry, up to twenty feet.

D. The flow rate of each pump shall be adjustable based on a 4-20 mA signal.

E. Pump suction and discharge shall be 3/4" I.D.

F. Pump skid shall be 110 volt, 60 Hz, single phase.

G. Electrical service for this system shall be provided from the existing electrical control panel at the site location shown on drawing. Contractor to verify condition of homerun and breakers to panel LP1-25 and replace if necessary to include running all wiring and conduit as needed.

H. Where chemical feed is necessary for continuous operation and for the protection of the water supply:

   a. a minimum of two feeders shall be provided.
   b. a standby unit or a combination of units of sufficient capacity should be available to replace the largest unit during shutdowns; and
   c. where a booster pump is required, duplicate equipment should be provided and, when necessary, a standby power.

I. A separate feeder shall be provided for each chemical applied. In addition, spare parts should be available for all feeders to replace parts which are subject to damage.

2.02 CHEMICAL FEED CONTROLS

A. The chemicals shall be applied to the water at such points and by such means as to:

   a. Assure maximum efficiency of treatment and good mixing of the chemicals with water.
   b. Assure maximum safety to consumers and the operators.

   c. Provide maximum flexibility of operation through various points of application when necessary; and

   d. Prevent backflow or back-siphonage at all feed points.

B. Provide and install a 3.5” color touch screen display to the existing PLC located in recirculation pump station location shown on drawings. This screen will allow operators to change set points for the chemical feed system.

C. Provide and install Phoenix radio system to send 4-20 mA signals from UV flow meter and ammonia probe to plc located in recirculation pump station locations shown on drawings.

D. Program existing PLC in panel located in recirculation pump station to receive signal from ammonia probe to start the chemical feed system at an adjustable set point and to pace the chemical feed system at a rate based on the signal from the flow meter from the UV system.

E. Add 24 volt power supply to power signal from UV flow meter

F. Install ammonia monitor at UV basin.

G. Provide all wiring, conduit required for power as needed from local existing UV cabinet.

H. Cross-connection control shall be provided to assure that no direct connection exists between any sewer and a drain or overflow from the liquid chemical feeder or liquid storage tanks by providing that all drains terminate at least six inches above the overflow rim of a receiving sump, conduit or waste receptacle.

2.03 CHEMICAL STORAGE TANKS

A. Provide two molded, seamless, filament wound, FRP tanks with a capacity of 6,000 gallons. The tanks shall be placed above ground on a concrete containment basin as shown on the drawings.

B. The tanks shall have one 24" bolted manway, 3 - 3" flanged nozzles and 1 -6” "U" vent with screened opening.

C. The tanks shall have a level gauge of 1½" clear PVC sight glass. Each tank shall have one 2" PVC filler line located in the top of the tank terminating with a 2" ball valve and stainless steel camlock male coupling with a PVC cap mounted on a stainless-steel shelf within the containment area.

D. The chemical storage tanks shall have an overflow and a receiving basin or drain capable of receiving accidental spills or overflows.

E. The chemical storage tanks shall be insulated and heat stripped. The head tracing system shall use an econotrace cable with dual thermostats. The system shall be 115 VAC. The heat panels must be able to maintain the chemical at 80° F. One thermostat shall be used for control, and one shall be used for overload safety. All thermostats shall be set by the Owner. The insulation shall be 2" of polyisocyanurate insulation with a vinyl acrylic weather barrier (Mastic WC-5).

F. Shop drawings for fiberglass chemical storage tanks shall be stamped by an engineer registered in Georgia.

G. Alum and caustic soda ash shall not be handled in open vessels but should be pumped in undiluted form from original containers through suitable hose, to the point of treatment or to day tanks.

H. Chemicals shall be stored in covered or unopened shipping containers, unless the chemical is transferred into an approved storage unit.

I. Offloading areas shall be clearly labeled to prevent accidental cross-contamination.

J. Acids shall be kept in closed, acid resistant shipping containers or storage units Acids shall not be handled in open vessels but should be pumped in undiluted form from original containers, through suitable hose, to the point of treatment.

2.04 HOUSING

A. Structures, rooms and areas accommodating chemical feed equipment shall provide convenient access for servicing, repair and observation of operation.

B. Floor surfaces shall be smooth and impervious, slip-proof and well drained with 2.5 % minimum slope.

C. Vents from feeders, storage facilities and equipment exhaust shall discharge to the outside atmosphere above grade and remote from air intakes.

D. Open basins, tanks and conduits shall be protected from chemical spills or accidental drainage.

2.05 PIPING AND APPURTENANCES

A. All piping, suction and discharge shall be 3/4" schedule 80 PVC. All valves, fittings and connectors shall be schedule 80 PVC.

B. All fill line pipes shall be 2" schedule 80 PVC. All fill line valves, fittings and connectors shall be schedule 80 PVC.

C. Fill line shall have a 2" stainless steel male camlock with a 2" plastic female camlock cap. There shall be a spill containment basin and an HDPE piping sump for the fill port.

D. All casing pipe and appurtenances shall be schedule 80 PVC.

2.06 HEAT TRACING

A. Provide heat tracing with controls for all PVC lines on the chemical system

B. Heat tracing to maintain a temperature of 80° F and should be self-regulating

C. All exposed PVC lines to receive UV resistant pipe insulation.

D. Heat tracing to be weather proof for outside installation.

2.07 CHEMICAL INFORMATION

A. For each chemical the information submitted shall include:

a. specifications for the chemical to be used;
b. purpose of the chemical;
c. proposed minimum non-zero, average and maximum dosages, solution strength or purity (as applicable), and specific gravity or bulk density;
d. method for independent calculation of amount fed daily; and
e. chemical hazards class, if any, and regulatory workplace health/safety and chemical exposure standards listed in Safety Data Sheets (SDS).

B. Chemical containers shall be fully labeled to include:

a. chemical name, purity and concentration;
b. supplier name and address; and
c. expiration date where applicable.

C. Chemicals shall be listed as meeting NSF Standard 60 and shall meet AWWA specifications, where applicable.

D. Provisions should be made for assay of chemicals delivered.

E. Chemicals shall not impart any toxic material to the water under recommended dosages.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the complete installation which must be in accordance with equipment manufacturer's recommendation.

B. The manufacturer should furnish supervision of all installation and supply a qualified service representative to instruct the Owner in the operation and servicing of the equipment.

C. All pipe penetrations through walls shall be cored and cased with schedule 80 PVC pipe. All penetrations shall be insulated and waterproofed.

D. Check valve shall be installed at end of chemical feed pipe run prior to discharge into wet well.

E. All piping shall be adequately supported with pipe clips and supported from frames constructed of galvanized steel, anchored to concrete. Support of the piping shall be at the minimum of 6’ of pipe run. All piping shall be installed plumb and level.

F. Support piping adjacent to chemical pump skid such that no weight is carried on pump skid.

G. Safety Items: Provide gloves, goggles, face mask, and apron suitable for use with the chemical involved. Provide signage to be mounted outside of door of chemical room as required by OSHA. Paint all tripping hazards with safety yellow paint. Provide carts and other appropriate means for lifting chemical containers to minimize excessive lifting by operators. The chemical building shall include an emergency shower and eye wash station.

END OF SECTION

SECTION 15282
BIOLOGICAL ODOR CONTROL SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install and test the biotrickling filter odor control system at the Headworks of the Folkston Water Pollution Control Plant in Folkston, Georgia. System shall be complete with all appurtenances as specified herein.

1. Manufacturer shall furnish biotrickling filter equipment including blower, biotrickling filter vessel, interconnecting ductwork between blower and vessel, flexible connectors, manual airflow dampers, nutrient addition system, water addition system and control panel along with instrumentation and controls for a fully functioning system.

2. The System is designed as a once-through, non-recirculating system. If a recirculating system is proposed, any additional equipment, duty/standby pumps, pH probe, double containment recirculation pipe and transmitters, etc. will be provided for a complete and operating system. The Manufacturer will be responsible for all changes or modifications to the equipment shown on the project plans.

3. Manufacturer shall provide shop drawings and Operation and Maintenance manuals.

4. Manufacturer shall provide startup and performance acceptance testing services as specified herein.

5. Placement, installation, bolting to the pad and connection of ductwork, water piping, drainage piping, power and control wiring provided by Contractor.

B. The System shall comprise of the following major components:

1. Single or multi-stage biotrickling filter vessel. The FRP vessel shall be comprised of at least one main module and one top piece and may contain additional modules as the design conditions require. Each media module shall house the structured synthetic media in series and contain a single water/nutrient injection spray system.

2. Structured, engineered, plastic, synthetic media to optimize mass transfer and facilitate the growth of bacteria necessary for biological oxidation of odorous compounds. The media bed shall be uniform and structured throughout and made entirely of a plastic, synthetic, non-reactive material.

3. A UL, factory-labeled electrical control panel housing a single Programmable Logic Controller (PLC) system and other components required for the control and monitoring of the System.

4. A water panel that houses all components necessary for the control and monitoring of the media irrigation system, including an Automatic Flow Control system with capability to automatically compensate for water supply pressure changes.

5. A single-pass irrigation system to allow the development of heterotrophic bacteria in the upper media zone. Systems that require recirculation will be considered for this application.

6. Odor control blower to move the odorous air from the source and be able to compensate for all pressure losses at the design airflow.

1.02 CONTRACTOR RESPONSIBILITY

A. Installation of all Manufacturer-supplied equipment components, which includes among others, receiving, offloading, placement and bolting of all equipment to the concrete pad, connection of ductwork, water piping, drainage piping, and power and control wiring, all in accordance with the Manufacturer's installation instructions.

B. If applicable, onsite storage and maintenance of all equipment, suitably protected, per the Manufacturers written instructions, from weather and any conditions that could adversely affect the material from its intended function.

C. Supply of all odorous air ductwork including flex connectors and damper valves upstream of the blower.

D. Site preparation and clearing.

E. Construction of concrete equipment pad for placement of the biotrickling filter(s) and supply of system anchor bolts.

F. External water piping and drain piping to and from the biotrickling filter(s) and Water Control Panels.

G. Power supply to the electrical control panel, power to the odor control blowers and connection of all ancillary instrumentation mounted remotely to the System Control Panels.

H. Installation of any additional items as noted on the contract drawings.

I. Heat tracing and insulation of any air ductwork, water pipes/tubes, and/or nutrient storage tanks as required by this Specification or elsewhere in the Contract Documents.

J. Adjusting and Balancing of all upstream odor sources.

K. Temporary piping for startup of the system.

1.03 PROCESS DESCRIPTION

A. The odor control system shall remove hydrogen sulfide, organic reduced sulfur compounds (RSCs) and/or other odorous compounds from the foul air stream, as required per Section 2.04 below, using a biotrickling filter operating in a counter-current fashion. Co-current systems shall not be allowed.

B. The foul air shall enter the system at the bottom of each reactor and flow upward through each of the media layers. The media bed shall be intermittently irrigated from above using suitable reclaimed plant effluent or potable water in a once-through fashion. The water then trickles through the media and is collected in a sump at the bottom of the reactor. The drain water from the system will pass from the sump in the bottom of the reactor vessel and be piped to a discharge point as detailed on the Contract drawings.

C. The hydrogen sulfide is oxidized by the autotrophic bacteria resident on the lower media layer(s). Because of the once-through irrigation configuration, a neutral-pH area of the media will be established, near the top of the media, providing conditions suitable for heterotrophic bacteria to oxidize other organic odorous compounds as required. The airstream is then released to the atmosphere via the exhaust stack at the top of the reactor.

1.04 REFERENCES

A. ASTM E679: “Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits”.

B. EN13725-2003 - Air Quality - Determination of Odor Thresholds by Dynamic Dilution Olfactometry.

C. ASTM D-2563: “Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts”.

D. ASTM D-2583: “Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor”.

E. ASTM C582: “Revision of C582-02 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment”.

F. ASTM D-883: “Definition of Terms Relating to Plastics”.

G. ASTM D-3299: “Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks”.

H. ASTM D-2996: “Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe

I. ASTM D 4167 – Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.

J. ASTM D-4097: “Standard Specification for Contact Molded Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks”.

K. ASTM D-3982: “Standard Specification for Contact Molded Fiberglass Ducts”.

L. PS 15-69: National Bureau of Standards Voluntary Product Standard “Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment”.

M. American National Standards Institute (ANSI).

N. American Society of Mechanical Engineers (ASME).

O. Institute of Electrical and Electronic Engineers (IEEE).

P. National Electrical Manufacturers Association (NEMA).

Q. National Electrical Code (NEC).

R. National Fire Protection Agency (NFPA).

S. National Bureau of Standards (NBS).

T. Underwriters Laboratories (UL).

U. American Society for Testing and Materials (ASTM).

1.05 SUBMITTALS

A. The Manufacturer shall submit information as required to show complete compliance with these specifications. Submittals shall be provided as six (6) hard copies and one (1) digital copy. At a minimum, this information should include the following:

1. A detailed list of any and all deviations and/or exceptions from this specification along with an explanation for the deviation/exception. Clearly list all benefits to the owner and the dollar figure refund due to the owner for the exception.

2. References for ten (10) systems using the proposed media, treating a minimum of 2,000 cfm and that have been in operation for at least ten (10) years.

3. Manufacturer's catalog/data sheets and descriptive literature for each piece of equipment supplied.

4. Technical data on each major piece of equipment including weights of all items greater than 200 lb.

5. Structural calculations and drawings for the main reactor vessel, to include wind and seismic load calculations, dead loads, live loads and anchor bolt sizing. Consideration shall be given to the effect of all cutouts and openings in the vessel. Calculations shall be signed and sealed by a Professional Engineer licensed in the State of Georgia.

6. Modeling results, in graphical format, with velocity contour plots at 24" media height over the entire media cross section shall be provided to confirm that the airflow through the media is homogeneous at the average airflow rate. For the purpose of this specification, homogeneous is defined as being when the upflow velocity over the entire media cross sectional area is equal to the average upflow velocity ± 10%.

7. Detailed bill of material complete with material of construction.

8. Dimensional drawings showing elevation and plan views of the System and all applicable connections.

9. Process and Instrumentation Diagram (P&ID) showing all main equipment components, flow rates and instrumentation.

10. Process control narrative.

11. Complete details on the Electrical and Water Control Panels:

    a. Heat calculations pertinent to installation in Georgia.
    b. Indemnification certificate for all control strategies and programs made out to the owner.
    c. Confirmation that all programming is done in-house and programs are the property of the Manufacturer.
    d. Details on the in-house Factory Acceptance Testing (FAT) procedures for review and approval of the engineer.
    e. Description of Automatic Flow Control equipment to demonstrate compliance with Section 2.05.D.3.

12. A list of the Manufacturers recommended Spare Parts for one (1) year's operation.

13. Equipment offloading and installation instructions with sufficient detail to allow the Contractor to complete the mechanical and electrical installation of all System components.

14. Annual utility and nutrient usage calculations (if applicable).

15. Statement of Manufacturer's Warranty.

16. Information on hazards associated with the System and appropriate safety precautions, including applicable Material Safety Data Sheets (MSDS).

17. Proposed Performance Testing Plan, to include a list of sampling and logging equipment and all sampling and testing methods and protocols.

B. The Manufacturer shall submit the following information, as a minimum, for the Operation and Maintenance Manuals.

1. As-built dimensional drawings showing plan and elevation views of the System and all applicable connections.

2. As-built Process and Instrumentation Diagrams (P&IDs).

3. Detailed bill of material along with specification of System components and materials of construction. The list to include the make, model number and descriptive literature of all items furnished by the Manufacturer.

4. Performance data for the odor control blower, to include curves showing capacity, pressure, horsepower demand and efficiency over the entire operating range, including blower manufacturer's descriptive literature and blower model number(s).

5. Special precautions for any components or materials associated with the System and its operation that should be subject to particular safety precautions, including MSDS.

6. Manufacturer's Service Department contact information and service order form.

7. Statement of Manufacturer's Warranty.

8. System startup and restart instructions.

9. Detailed information on proper settings and operation of the Automatic Flow Control System.

10. Special maintenance procedures, including recommended weekly, monthly and annual preventative maintenance requirements.

11. Troubleshooting guide.

12. Individual Operation and Maintenance instructions for all major system components.

13. O&M manual shall be provided in digital copy for review/comment/approval. After approval, the Manufacturer shall provide four (4) hard copies for the owner's records.

1.06 SHIPPING, DELIVERY, STORAGE, & HANDLING

A. All equipment and materials shall be properly protected such that no damage will occur from the time of shipment until the time of installation.

B. All exposed openings shall be protected to prevent entrance of debris, moisture or water during transportation and storage.

C. Contractor shall be responsible for offloading all shipped equipment and shall inspect all equipment upon arrival. Contractor shall notify the Manufacturer within 24 hours of any damage to equipment or surface finish due to shipping.

D. Contractor shall store all equipment such that, for the duration of the storage period, there will be no deterioration in equipment appearance or performance. Manufacturer shall supply detailed storage instructions, as necessary, at the time of shipment.

1.07 WARRANTY

A. The biotrickling filter Manufacturer shall warrant that the equipment supplied meets these specifications and the performances detailed in section 2.04 and that it is new and unused, free from defects in materials and/or workmanship. This warranty shall be for 18 months from equipment delivery to the job site or 12 months from equipment handover, whichever comes first. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents.

B. The biotrickling filter Manufacturer shall warrant the plastic, synthetic media against defects in material and workmanship for five (5) years from equipment delivery. In addition, the manufacturer shall warrant the media against shrinking, swelling or plugging (such that the design airflow cannot be achieved) for a period of five (5) years. In the event that it is determined that a defect exists, at the Manufacturer's discretion, the Manufacturer shall repair or replace the defective components, provided that any such defect was not the result of misuse of the component by the Owner or his agents. The inability of the System blower (s) to provide the full design airflow will indicate failure of the media.

C. The biotrickling filter Manufacturer shall warrant that the irrigation spray nozzles shall remain clog and maintenance free for ten (10) years.

D. All System Warrantees are predicated on operation and maintenance of the System being in accordance with the Manufacturers written O&M manual and inlet conditions being in-line with these specifications. Demonstration of the above will be provided through written logs and records provided by the owner.

PART 2- PRODUCTS

2.01 GENERAL

A. The odor control equipment supplied under this section must be provided by a single Manufacturer who will be solely responsible for the design, delivery and performance of the system. The equipment must be new and unused and meet the detailed specifications and warranty requirements stated herein.

2.02 QUALITY ASSURANCE

The Manufacturer shall be an industry recognized process company specializing in the design, manufacture and operation of biological odor and air emissions equipment utilizing a once-through (non-recirculated) irrigation system.

The System Manufacturer shall have the following full-time employees on staff to ensure proper system support: mechanical engineer, environmental engineer, electrical engineer and a dedicated service department.

Any manufacturer whose main business is FRP manufacturing will not be accepted as a supplier for the odor control system specified herein.

The biotrickling filter Manufacturer is responsible for the coordination of all equipment specified herein. Systems shall be as manufactured by BioAir Solutions, LLC. or pre-approved equal only. Proposal of an unnamed Manufacturer after the bid will not be considered.

A. Experience Requirements

The biological odor control system Manufacturer shall be experienced in the design, manufacture, installation and operation of biotrickling filters designed to remove hydrogen sulfide and organic RSCs from municipal water and wastewater odor sources. The System Manufacturer shall have a minimum of ten (10) years of experience producing substantially similar equipment and shall show evidence of at least thirty (30) systems (using the media specified herein) in satisfactory operation for at least ten (10) years in the United States.

B. Substitution

Any substitutions or deviations in equipment or arrangement from that shown on the drawings or specified herein shall be the responsibility of the Contractor. Any deviation must be accompanied by detailed structural, mechanical and electrical drawings and

additional supporting data for review by the Owner and the Owner's Engineer and must be stamped and certified by a registered Professional Engineer (PE) licensed in the State of Georgia.

All costs associated with the review of substitutions or deviations, and costs to the Engineer or Owner associated with project drawing changes as a result of approval of the substitution, shall be borne by the Contractor. There shall be no additional costs to the Owner due to substitutions or deviations.

C. Acceptable Manufacturers

Where a Manufacturer's standard equipment name is used in these specifications, the intent is to establish a minimum standard in terms of equipment quality, performance, functionality and experience. Substitutions as detailed above must be pre-approved by the engineer prior to bidding. Request for pre-approval must be received in writing 21 days prior to the bid opening date and must include the following supporting documentation and information –

1. A detailed list of any and all deviations and/or exceptions from this specification along with an explanation for the deviation/exception.
2. Provide project specific drawings showing arrangement of biotrickling filter, blower and electrical and water control panels.
3. Performance data from a minimum of ten (10) operating systems demonstrating media elimination capacity ≥ 10% greater than the proposed system loading.
4. Provide project specific Process and Instrumentation Diagram (P&IDs)
5. Calculations showing cost of operation – power consumption, water consumption, nutrient consumption, expected biotrickling media life, carbon life calculations, etc.
6. A list of ten (10) similar installations with contact names and phone numbers, length of time in operation and volume of air being treated. Provide performance data for each reference, showing H_2S removal % and % of overall odor removed. Each of the installations must use the same media as proposed for this project and must be operating a once-through irrigation system. Systems using any form or recirculation will not be considered for evaluation as an equal for this project.
7. Installation list detailing equipment capacity, length of time in service, performance record and performance records for two installations for a minimum one (1) week duration for each system.
8. Resumes for in-house Mechanical and Electrical Engineering staff, Process Manager and all in-house Service personnel.
9. Local service center details.
10. Qualifications of key individuals

11. Company financial documentation – D&B report, Bonding Capacity, etc.

In addition, the following may be included to aid the evaluation process –

i. Cut-sheets, bulletins, company brochures, etc.
ii. Testimonial or recommendation letters from previous customers
iii. Published Industry technical papers / bulletins

2.03 OPERATING CONDITIONS

The System shall be suitable to treat air coming from a continuous supply from the odor source and all equipment must be suited to the operating conditions to which it will be subjected and the various compounds/substances with which they will reasonably be expected to come into contact. The operating conditions, at a minimum, include the following:

Purpose:	Continuous air supply and odor source
Location:	Outdoors, Adjacent to Headworks
Inlet Air Temperature:	55-100°F
Inlet Relative Humidity:	60-100%
Contaminants:	Hydrogen Sulfide, Organic RSC's, Ammonia

2.04 DESIGN REQUIREMENTS

A. At a minimum, the System shall treat the following and meet the following minimum performance criteria:
B. Performance Requirements (H_2S):
C. The system shall have passed the performance test if any one of the following conditions is true:

1. Average H_2S removal efficiency is greater than or equal to 99% for inlet air H_2S concentrations that are greater than or equal to 50 ppmv but less than or equal to 300 ppmv.
2. Average outlet H_2S concentration is less than or equal to 0.5 ppmv for inlet air H_2S concentrations that are less than or equal to 50 ppmv

2.05 SYSTEM COMPONENTS

A. Biotrickling Filter Vessel

1. The biotrickling filter vessel shall be free standing and of vertical "tower" configuration operating in a counter-current manner. Each vessel shall consist of one (1) or more modules containing structured media and one (1) top piece. Each module shall be constructed from Fiberglass Reinforced Plastic (FRP) and be designed with adequate strength to support the number of required modules. Each FRP module shall contain, as a minimum, a 100 mil vinyl ester resin corrosion barrier. The structural layer shall consist of isophthalic resin with chop strand and continuous glass. The exterior top coat shall be isophthalic resin with UV resistant pigment (minimum service life of 10 years). The exterior color shall be CCP base white enamel (W005).

2. Biotrickling filter vessels shall not provide access to any area beneath the media or any location within the vessel where there is a chance for dripping acidic filtrate or hydrogen sulfide gas.

3. The reactor vessels shall be provided with 316 stainless steel hold down lugs to account for all anticipated loads to comply with local wind code requirements.

B. Media

1. The structured media shall be EcoBase® or approved equal, high porosity, chemically resistant, engineered, plastic, synthetic porous material made from polyvinyl chloride, polyethylene or polyurethane. Organic media, carbon derived lava rock or lava rock media and/or random synthetic or non-synthetic inorganic media materials shall not be allowed.

2. The media characteristics (available surface area, density, and pressure drop) shall be structured and uniform throughout the media bed with pre-manufactured, engineered flow channels. Random media types (chips, clay balls, foam cubes, etc.) shall not be allowed.

3. The media shall have a minimum available specific surface area of 230 ft2/ft3 and a void opening of more than 96%. Pressure drop shall not exceed 0.1" w.g. per ft of media depth.

4. The media shall be guaranteed not to clog or require cleaning, scrubbing, backwashing, acid-washing or replacement for a period of ten (10) years.

5. Media beds / stages shall be self-supporting, enclosed in a shell or otherwise removal as a single piece. Entry into the vessel shall not be necessary for media removal.

6. Media shall resist compaction or swelling due to varying moisture levels and shall not degrade when subjected to low pH (i.e. pH < 2) conditions.

7. The uniform structure of the media shall minimize the potential for short circuiting and encourage a uniform water and air flow pattern over the entire media cross sectional area.

8. The manufacturer shall provide evidence that the airflow through the media at 24" height from the bottom of the media is homogeneous at the average airflow rate. For purposes of this specification, homogeneous is defined as being when the upflow velocity over the entire media cross sectional area is equal to the average upflow velocity ± 10%. The airflow modeling results with velocity contour plots at 24" media height over the entire cross section shall be provided in graphical format as part of the Submittal requirements.

9. Sufficient media shall be provided to ensure the performance requirements listed in section 2.04 are met.

10. Media shall be pre-installed in the FRP module (s) by the system manufacturer prior to shipment to the job site. Medias that require a contractor for installation or placement are not permitted.

C. Irrigation System

1. Each reactor shall be configured with at least one (1) irrigation point which shall distribute the irrigation water evenly over the entire upper surface of the media layer.

2. The irrigation system will, without exception, be a once-through system.

3. Spray nozzles shall be 316 Stainless Steel, without exception and shall be warranted to not clog or require maintenance for a ten (10) year period.

4. Each spray nozzle shall be tested by the Manufacturer and a certificate of conformity supplied with the shop drawings to show that the nozzle has been tested and meets the specified standards for uniform distribution.

5. Spray nozzle array systems with multiple nozzles, shall not be acceptable.

6. The irrigation system shall be supplied with a nutrient addition system to provide the macro and micronutrients required by the bacteria for optimal metabolism of the odorous compounds being treated.

D. Control System

1. Electrical Control Panel (ECP)

The ECP enclosure shall be NEMA 4X and constructed of 316SS, and the panel shall come with a 316SS panel stand.

The ECP shall house the necessary electronic components and an Allen Bradley MicroLogix 1400 PLC with PanelView 800 (HMI) for the control and monitoring of the irrigation system. Dry contacts shall be provided for external notification of alarm status. Alarms, at a minimum, shall be provided for low irrigation water flow, high irrigation water flow, no nutrient flow (if applicable) and blower fail. An Ethernet connection shall be provided to allow for remote monitoring/control of the system. There shall be an allowance to manually open the irrigation spray valve (located in the water control panel) for the purpose of routine maintenance checks but the valve should be normally closed.

The system shall contain a PLC with an Ethernet/IP port, two (2) serial ports, on-line editing capability, a built-in backlit LCD screen, and a built-in high speed counter. The PLC shall be expandable with up to seven (7) additional input/output modules.

The ECP shall monitor and log water flow and provide the following summary –
Daily water consumption
Weekly water consumption, etc.

The ECP shall require a single electrical connection of 480V/3Phase/60Hz. Transformers shall be provided as necessary for power and control voltages. A 120 volt, GFCI convenience outlet shall be provided in the ECP.

2. Water Control Panel (WCP)

The Water Control Panel shall be constructed of 316SS and be mounted on the common 316SS panel stand, back-to-back with the ECP.

The WCP shall contain a panel heater, valves, motorized ball valves, strainers, instruments and piping for the control of the irrigation system and shall operate

from control signals from the ECP.

The WCP shall contain, without exception, a pulse generating, paddlewheel water flow meter. Irrigation water flow shall be monitored and recorded to ensure proper operation and aid in trouble-shooting. Monitoring irrigation water pressure alone is not acceptable.

The WCP shall allow for a single connection to either a potable water source or suitable final effluent plant water source.

The WCP shall house the nutrient addition system.

The WCP shall also contain a flexible spray hose with a hand trigger to allow for convenient rinsing of the strainer, filling of the nutrient barrel, and general convenience. A dedicated ball valve shall be provided in front of the spray hose to allow for the operation of the water panel while simultaneously allowing for isolation in case of a leak in the hose.

3. Automatic Flow Control System

   Without exception, the ECP and WCP shall contain the necessary programming, circuitry, and hardware for an Automatic Flow Control System, which shall have the following features and shall be capable of meeting the Automatic Flow Control System performance test outlined in Section 3.05.E.

4. The system will periodically monitor the irrigation water flow rate during the irrigation sequence.

5. If the irrigation water flow rate is outside of the target flow range the irrigation valve will automatically adjust to correct the irrigation water flow rate.

6. The following parameters shall be operator-adjustable:
   a. Target irrigation flow rate
   b. Allowable flow error
   c. Amount of valve adjustment when error is detected
   d. Flow evaluation period

7. The following non-adjustable readings shall be shown on the ECP HMI:
   a. Instantaneous irrigation water flow rate
   b. Actual irrigation valve open %

   The following will NOT be considered to be meeting the Automatic Flow Control

Systems requirements:

a. Systems using irrigation valves that are only capable of fully-open or fully-closed operation. Solenoid Valves do not meet this requirement and are not allowed.
b. Systems using mechanical-only means of adjusting the irrigation water flow such as manual diaphragm valves, globe valves, pressure reducing or adjusting valves.
c. Systems that require operator interaction in order to correct the irrigation water flow.

E. Dampers

1. Flow Control Dampers shall be constructed of vinyl ester resin, of the single blade type complete with channel type frame, close fitting blade, full circumference blade stop, full length 316 stainless steel axle, and bearings. Dampers shall have the same inside dimensions as the connecting piping.

2. Isolation Dampers shall be constructed of vinyl ester resin, of the single blade type complete with channel type frame, close fitting blade, neoprene or EPDM blade and Viton shaft seals, full length 316 stainless steel axle, and bearings. Each damper shall have the same inside dimensions as the connecting piping.

3. Dampers shall be Swartwout, BioAir, Belco or approved equal.

F. Odor Control Blower

1. The blower(s) shall be single-width wheel, single-inlet as designed and manufactured by Verantis, The New York Blower Company or approved equal.

2. The blower shall be constructed such that all surfaces in contact with the odorous airstream are to be made of corrosion resistant FRP.

3. All nuts, bolts and fasteners in contact with the gas stream shall type 316 SS.

4. Blowers shall be AMCA Arrangement 9 or 10. AMCA Arrangement 4, which places the motor shaft in the odorous airstream, is not allowed.

5. Blower ratings shall be based on tests made in accordance with AMCA Standard 210 and licensed to bear the AMCA Certified Ratings Seal for Air Performance. Blowers not licensed to bear the AMCA Seal for performance shall be tested, at Contractor's expense, in an AMCA Registered Laboratory.

6. Blower brake horsepower shall be equal to or less than 0.7 BHP at 550 CFM and 4 inches static pressure.

7. Blower shall be constructed in accordance with ASTM D-4167 standard specification for FRP blowers and blowers to ensure structural integrity.

8. Blower housing shall be constructed of polyester resin.

9. Wheel shall be radial, or backwardly inclined, non-overloading design. Wheel shall be fabricated of vinyl ester resin.

10. Wheel hub shall be securely fastened to the shaft and completely encapsulated in FRP to ensure corrosion-resistant integrity. Wheels shall be ground and polished carbon steel, encapsulated in FRP.

11. The blower motor shall be a standard efficiency, Class I, Div. 2, 480V/3Phase/60Hz electric motor as manufactured by US Electric Motors, Baldor, Reliance or approved equal.

12. Blower shall be equipped with a Teflon shaft seal.

2.06 EQUIPMENT NAME PLATES

Each separate piece of equipment shall be furnished with a unique name plate identifying the Manufacturer, model & serial number, date of manufacture and, if applicable, capacity and any performance limitations. The nameplates shall be Gravograph Gravoply 2 ply plastic and firmly affixed to the exterior surface of the equipment and in a location that is accessible and easily read.

2.07 SPARE PARTS

At a minimum, the following spare parts shall be supplied with the equipment.
One (1) set of fuses, one (1) for each fuse rating.
One (1) set of lamp lenses.
One (1) strainer.
Spare parts shall be stored, by the Contractor, on site and shall be handed over to the Owner at equipment handover.

PART 3- EXECUTION

3.01 FACTORY ACCEPTANCE TEST

A. Reactor Vessel

FRP reactor vessel shall be inspected prior to shipping for conformance to the following:

1. Dimensions match those shown on submittal drawings and are within Manufacturer's specified tolerances.

2. Flanges and connections between reactor parts fit securely without improper bending or stressing of parts.

3. Damage or imperfections to paint or fiberglass work, including cracking/crazing are minimal and in accordance with FRP specifications in Section 2.05A.

4. Manufacturer shall keep a record of the quality control document for each reactor vessel(s) that is available to the Engineer upon request.

B. Electrical Control Panel

Electrical control panel shall be inspected prior to shipping for conformance to the following:

1. NEMA rating according to Section 2.05D and bear the UL508 label.

2. PLC program and HMI shall be tested for proper communication and functionality.

3. PLC digital and analog inputs shall be electrically tested to ensure input recognition in the proper area of the PLC program.

4. All wiring between panel components and terminal strips shall be checked for proper labeling and connection.

C. Water Panel

All water panel piping and/or other pre-installed piping shall be tested prior to shipping for conformance to the following:

1. System shall have no leaks when subjected to a pressure test at 80 psi for a minimum of 1 hour.

2. All installed instruments, sensors, pumps, actuated valves, and other electrical components shall be tested for proper operation.

3. All wiring from terminal strips to all electrical components shall be tested to ensure proper wiring.

D. Spray nozzle

Spray nozzle shall be factory tested to ensure compliance with Manufacturer standards for uniform distribution.

E. FAT log

Prior to release for shipment, the Manufacturer shall Submit to the engineer for approval the results of the FAT demonstrating that Testing is complete and that the controls are ready for shipment and installation.

3.02 INSTALLATION & EQUIPMENT START-UP

As far as is reasonably possible, all equipment should be pre-assembled prior to shipment, to minimize the need for on-site assembly. Media should be pre-installed by the Manufacturer and certified to meet the specified performance requirements.

Installation of all equipment will be conducted by the Contractor and must be in accordance with Manufacturer's written installation and startup instructions and by workers experienced in the handling of fiberglass vessels, electrical work, plumbing and instrumentation. The final installation must be certified by the Manufacturer as complete and correct.

The Manufacturer shall provide the Contractor with required clearances, tolerances and limitations, such as smoothness/flatness of concrete pad and shall be available to answer questions prior to and during the installation of the equipment.

Once the installation has been certified by the Manufacturer, the Contractor, with assistance from the Manufacturer, shall start the System to begin the biological acclimation period. This startup period shall take no longer than six (6) weeks but at any point during this startup period, at the discretion and direction of the Manufacturer, the contractor shall switch the system over to normal operation. Any minor re-piping or plumbing required will be clearly detailed in the Manufacturer's installation and startup

manual and will be performed by the Contractor.

Any special tools or materials required for this startup/acclimation period shall be provided by the Manufacturer.

After satisfactory startup and the corresponding switch over to normal operation, the Contractor shall, in the presence of the Engineer, conduct the performance test as detailed in section 3.05 below.

3.03 FIELD PAINTING & CORROSION PROTECTION

If painted surfaces are damaged during shipment, off-loading or installation, as long as the damage is surface only and in no way affects the integrity of the equipment or its ability to perform, these blemishes, scratches or other imperfections shall be touched up by the Contractor in accordance with instructions from the Manufacturer. Materials used shall me compatible with the original coating material in quality and color.

3.04 PERFORMANCE TESTING

Performance testing shall not commence until the Manufacturer and Engineer agree that they system has been satisfactorily started-up and sufficient time has been allowed for the acclimation of the bacteria.

After the odor control system has been satisfactorily started-up and switched to normal operation, the Contractor shall, in the presence of the Engineer, demonstrate that the system will perform as specified in section 2.04 of this specification.

The Contractor shall provide the Engineer with a written test protocol and the performance test may not be conducted until the test protocol has been reviewed and approved by the Engineer.

The Manufacturer may be present during the performance test and, at its own discretion, may conduct a parallel performance test as long as they do not interfere with the performance test being conducted by the Contractor.

The Contractor shall supply, install and operate all equipment, sensors and instrumentation required to complete the performance test.

A. H2S Testing procedure

1. Measure airflow into each unit and, if necessary, adjust to the design airflow of 550 cfm +/- 10%. Airflow balancing can be conducted by the Manufacturer and

witnessed by the Engineer and/or Contractor if desired. Airflow shall be measured at the beginning of the test period. The set position on the damper(s) will be marked or noted. Airflow will not change as long as damper(s) remain in position.

2. Measure pressure drop across each biotrickling filter at beginning of test period.

3. Measure temperature of the inlet, outlet and ambient air.

4. Performance test period to begin at a noted time and last for four (4) hours. H2S data from the common inlet location and from the outlet of each odor control system will be measured and logged once every 10 minutes to demonstrate performance during test period.

5. The inlet H2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the inlet air stream (0-1000 ppmv or 0 - 200 ppmv range, 1 ppm display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).

6. The outlet H2S data will be logged with a pre-calibrated OdaLog gas data logger with appropriate range and accuracy for the outlet air stream. (0.00 - 2.00 ppmv range, 0.01 ppmv display resolution or 0.0 - 50.0 ppmv range, 0.1 ppmv display resolution).

B. H2S Acceptance criteria:

1. The System's H2S removal efficiency shall be determined by calculating the average inlet H2S concentration and the average outlet H2S concentration and using the following formula: H2S removal efficiency (%) = (1 – (average outlet H2S concentration/average inlet H2S concentration)) x 100. The system shall have passed the H2S performance test if the H2S removal efficiency is 99% or more for inlet air H2S concentrations ≥ 50 ppmv but ≤ 300 ppmv, or the average outlet air H2S concentration is ≤ 0.5 ppmv, whichever is greater.

2. In the event that the average inlet H2S concentration during the four (4) hour test period exceeds the specified average inlet H2S concentration as listed in this Specification, or the maximum inlet H2S concentration during the four (4) hour test period exceeds the specified maximum inlet H2S concentration as listed in this Specification, the H2S acceptance criteria shall not apply and the system shall be considered to have passed the performance test.

C. Automatic Flow Control System testing procedure

In the presence of the Engineer, the Manufacturer shall demonstrate the operation of the Automatic Flow Control System as given below.

1. Review the requirements list given in Section 2.05.D.3 and prove or demonstrate compliance with each point.

2. The following procedure shall be followed for each irrigation valve in the system. The cycle time shall be minimized to allow the procedure to be completed within 30 minutes.

    a. Open all manually controlled valves allow for maximum flow through the WCP. Set the target irrigation flow rate to 3x the normal irrigation flow rate (to allow the irrigation valve to fully open). Demonstrate that the valve will reach 100% open status within 20 s during irrigation.

    b. In between irrigation cycles, while the irrigation valve is CLOSED, set the target irrigation flow rate to the proper design irrigation flow rate. Demonstrate that the irrigation valve will automatically close in order to reach the design flow rate within 30 s during its next irrigation cycle.

    c. Repeat steps a. and b. above for a minimum of 3 additional set points both above and below the normal target irrigation flow rate.

    d. Set the target irrigation flow rate to the normal target irrigation flow rate. Partially close at least one valve upstream of the modulating ball valve and demonstrate that the irrigation valve will automatically adjust to a more open position in order to reach the design flow rate within 30 s during its next irrigation cycle.

    e. Return all Automatic Flow Control settings to their normal positions and fully open all upstream and downstream valves. Demonstrate that the system will return to normal flow control operation.

3.05 MANUFACTURER'S SERVICES

In addition to being available by phone to assist the Contractor during the offloading, installation, and startup of the equipment, the following Manufacturer's services shall be provided with the number of trips and days on site as a minimum.

Startup assistance	One (1) trip, two (2) days on site
Performance testing assistance/training	One (1) trip, one (1) day on site

Notwithstanding the above, the Manufacturer shall continue to assist the Contractor with questions, issues and remote assistance until the system is properly installed, running satisfactorily and handed over to the Owner.

END OF SECTION

SECTION 15290
REFRIGERATED AUTO SAMPLER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. A refrigerated sampler for the representative collection of liquid water samples to monitor influent and effluent waters from municipal and industrial NPDES facilities, monitor effluent waters from indirect industrial dischargers for compliance with pre-treatment regulations, and environmental monitoring including CSO and SSO studies and storm water run-off.

B. The sampler shall be an all weather refrigerated sampler.

C. Suitable for indoor or outdoor use

D. UL Certified.

1.02 MEASUREMENT PROCEDURES

A. The method of sample collection shall be via high-speed peristaltic pump for collection of the sample liquid.

B. The method of sample detection shall be ultrasonic.

1.03 ALTERNATES

A. Samplers that do not use a high-speed peristaltic pump will not be approved.

B. Samplers that are not configured with the compressor at the top of the cabinet will not be approved

C. Sampler temperature control systems that rely on a knob to set “colder or warmer” will not be approved.

D. Units that are not UL certified will not be approved.

1.04 PERFORMANCE REQUIREMENTS

A. Sample cooling: maintain sample liquid at 4°C (39°F) in ambient temperature to 50°C (122°F) maximum; accurate to ±0.8°C (±1.5°F).

B. Sample volume: programmable in 10 mL increments from 10 to 10,000 mL.

C. Sample volume repeatability ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in vinyl intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

D. Pacing intervals: selectable in single increments from 1 to 9,999 flow pulses or 1 to 999 hours in 1 minute increments. Accepts 4-20mA input from an external device to pace the sampler.

E. Vertical lift: 8.5 m (28 ft.) using 8.8m (29 ft.) maximum of 3/8-in. vinyl intake tube at sea level at 20 to 25°C (68 to 77°F).

F. Sample volume accuracy: ±5% of 200 mL sample volume with: 4.6 m (15 ft.) vertical lift, 4.9 m (16 ft.) of 3/8- in. vinyl intake tube, single bottle, full bottle shut-off at room temperature and 1524 m (5000 ft.) elevation.

G. Sample transport velocity: 0.9 m/s (2.9 ft./s) at 4.6 m (15 ft.) vertical lift (16 ft. of 3/8-in. vinyl intake tubing at 70°F at 5000 ft. elevation).

H. Pump flow rate: 4.8 L/min (1.25 gpm) at 1 m (3 ft.) vertical lift with 3/8-in intake tube typical.

1.05 CERTIFICATIONS

A. Controller: CE

B. Cabinet: UL/CSA/CE

1.06 OPERATIONAL CRITERIA

A. Operating temperature: 0 to 50°C (32 to 122°F)

B. Operating temperature with optional controller compartment heater: -40 to 50ºC (-40 to 122ºF)

C. Storage temperature: -30 to 60°C (-22 to 140°F)

1.07 WARRANTY

A. The product includes a one-year warranty from date of shipment.

1.08 MAINTENANCE SERVICE

A. Scheduled maintenance: monthly: visual inspection, if necessary, clean.

B. Unscheduled maintenance:

   a. Pump tube replacement
   b. Rotor removal and cleaning
   c. Distributor arm tubing replacement
   d. Desiccant replant

PART 2 – PRODUCTS

2.01 MANUFACTURED UNIT

A. The hatch is to consist of a controller and all weather refrigerator.

B. Tubing:
   a. Pump tube: 0.95 ID x 0.16 OD cm (3/8 ID x 5/8 in. OD)
   b. Intake tube: 9.5 mm (3/8 in.) ID vinyl or Teflon® lined polyethylene in 10- , 25- , or 100-ft. lengths

C. Weighted strainer constructed of 316 stainless steel and Teflon.

2.02 EQUIPMENT

A. The controller housing of the AS950 sampler is submersible, watertight, dust-tight, corrosion- and ice-resistant to NEMA 4X, 6, IP68 standards.

B. The Graphics Display is 1/4 VGA, Color; self-prompting/ menu-driven program.

C. The desiccant cartridge, which prevents moisture from accumulating inside the controller electronics area, shall be visual and accessible externally from the side of the controller; the replacement of the desiccant shall not require tools or disassembly of controller from base.

D. The pump shall use spring loaded rollers and be accessible by a clear hinged cover with single thumbscrew.

E. Refrigerated cabinet is insulated with 3-inch rigid foam insulation on the walls, 6 inches on the bottom and 5 inches on top. The cover for the controller compartment shall also be insulated.

F. The cabinet shall have a heavy duty compressible gasket on controller compartment lid, compressor compartment lid and refrigeration compartment door.

G. The refrigeration components and copper plumbing shall be corrosion protected with conformal coating.

H. The thermal control system is digital microprocessor-based and responds to a system of temperature sensors that continually monitor the evaporator plate, controller compartment air temperature, and refrigerated compartment air temperature.

I. An air sensing thermostat is capable of maintaining sample liquid within specified limits.

J. The power requirement is 115 Vac, 60 Hz (230 Vac optional)

K. Communication choices include:
    a. USB and optional RS485 (Modbus)
    b. Permits embedded software upgrades in the field
    c. FSData data management software used to download, analyze, and report data, save templates, download sample history and event logs, create graphs for reports and presentations. Link directly to PC A to A USB cable.

L. The membrane switch keypad user interface is self-prompting/menu driven program with 2 multiple function soft keys.

M. Sampling pacing modes shall include Time Weighted, Flow Weighted, Time Table, Flow Table, and Event.

N. Internal software shall be protected by a 7 amp fuse.

O. Diagnostics: View event and alarm logs.

P. A program lock shall be provided for access code protection to prevent tampering of program and system settings.

Q. The sampler is convertible to composite operation by installing a composite container and full bottle shut off.

R. Sample containers include choice of:
    a. Composite
        i. (2) 2.5 gallon polyethylene bottle
        ii. (2) 2.5 gallon glass bottle
        iii. (2) 5.5 gallon polyethylene bottle

b. Discrete
    i. (2) set of (8) 2.3 liter polyethylene bottles
    ii. (2) set of (8) 1.9 liter glass bottles
    iii. (2) set of (12) 2 liter polyethylene bottles
    iv. (2) set of (24) liter polyethylene bottles
    v. (2) set of (24) 350 ml glass bottles
    vi. (2) set of (2) 2.5 gallon polyethylene bottles
    vii. (2) set of (2) 2.5 gallon glass bottles
    viii. (2) set of (4) 2.5 gallon polyethylene bottles
    ix. (2) set of (4) 2.5 gallon glass bottles

S. Sampling features include:

a. Dual programming: Up to 2 sample programs can be run sequentially, in parallel, or according to day of week scheduling; enabling a single sampler to function like multiple samplers.

b. Cascade sampling: for two samplers in combination—the first sampler, at the completion of the program, initiates the second.

c. Status Screen: Communicates what program is running, if there are any missed samples, when the next sample will be taken, how many samples remain, number of logged channels, time of last measurement, memory available, number of active channels, if alarms were triggered, when alarms were triggered, active sensors and cabinet temperature

T. Datalogging
    a. Sample History: Stores up to 4000 entries for sample time stamp, bottle number and sample status (success, bottle full, rinse error, user abort, distributor error, pump fault, purge fail, sample timeout, power fail and low main battery)

    b. Measurements: Stores up to 325,000 entries for selected measurement channels in accordance with the selected logging interval.

    c. Event Log: Stores up to 2000 entries. Records Power On, Power Fail, Firmware Updated, Pump Fault, Distributor Arm Error, Low Memory Battery, Low Main Battery, User On, User Off, Program Started, Program Resumed, Program Halted, Program Completed, Grab Sample, Tube Change Required, sensor communication errors, cooling failed, heating failed, thermal error corrected.

U. Automatic

   a. Multiple bottle mode: after complete revolution of distributor arm (unless continuous mode is selected).

   b. Composite mode: after preset number of samples have been delivered to composite container, from one to 999 samples, or upon full container.

V. Sample distribution modes include single bottle composite, multi-bottle composite, multi-bottle discrete, bottles per sample, samples per bottle or a combination of bottles per sample and samples per bottle

W. Manual grab sample can be made with the AS950 sampler to deliver a grab sample to a specific bottle location

X. The high-speed peristaltic sample pump uses four rollers with spring tension.

Y. The intake air purge is made automatically before and after each sample. The duration automatically compensates for varying intake line lengths.

Z. The intake line is optionally rinsed with source liquid prior to each sample from one to three times.

AA. The sample collection cycle is optionally repeated from one to three times if a sample is not obtained on the initial attempt.

2.03 COMPONENTS

A. Standard equipment shall be:
   a. Controller: high impact injection-molded ABS/PC plastic

   b. All weather cabinet: linear low density polyethylene with UV-inhibitors

   c. Pump enclosure: corrosion-resistant polycarbonate door, high impact-resistant plastic, polyphenylene sulfide track

   d. Intake strainers in standard size, high velocity, or low profile for shallow depth applications. Choice of:
      i. Teflon and 316 stainless steel construction
      ii. All 316 stainless steel

   e. Exterior dimensions shall not exceed 51” H x 30” W x 32” D.

2.04 ACCESSORIES

A. Controller compartment heater

B. Bottle kits

C. Tubing and strainers

D. AC battery back up

E. Cables and interfaces

F. Anchor brackets

G. FSData software

H. IO9000 Input/output Module

END OF SECTION

SECTION 15300
VALVES (SEWER)

PART 1 - GENERAL

1.01 REFERENCE

A. Requirements of Section 1500 apply to all work under this section.

1.02 GENERAL

A. All valves two inches in diameter and smaller shall be constructed of brass or bronze except the hand wheel which shall be of malleable iron construction. Valves two inches in diameter and smaller shall have screwed ends unless approved otherwise. All valves 2½ inches in diameter and larger shall have flanged ends unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze at the Contractors option and expense.

B. The Contractor shall prepare and submit for approval complete detailed drawings of all valves in accordance with the requirements of the appropriate section of these specifications. All valves of the same type shall be from a single manufacturer. Parts of valves of the same type and size shall be interchangeable. Spare parts shall be furnished as specified under the proposal items. Special tools required for repacking or disassembling valves shall be provided.

C. All valves shall be carefully mounted in their respective positions free from all distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project. All valves shall open left.

PART 2 - PRODUCTS

2.01 NUTS AND BOLTS

A. Flanged: square head MB/SF, hexagon nuts; ASTM 307B; ANSI B18.2, zinc plated.

2.02 GASKETS

A. Flanged pipe gaskets shall conform to requirements of ASA A21.10 and shall be suitable for the indicated services.

2.03 VALVES

A. Gate Valves

1. Unless otherwise specified or directed, gate valves three inches and larger shall have non rising stems and shall meet the requirements of AWWA Standard C 500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thicknesses and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 100 psi.

2. Unless otherwise specified or directed, gate valves smaller than three inches shall meet the requirements of Federal Specification WW V 54, Class A, 125 pounds.
3. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze as specified or required. The glands shall be bronze or bronze brushed. Gland bolts and nuts shall be bronze.

4. All gate valves 2½ inches in diameter and larger shall be of the double disk type. All gate valves two inches in diameter and smaller may be of the double disk or the solid wedge type.

B. Plug Valves

1. Two way type.

2. Nonlubricated, eccentric with resilient faced plugs.

3. Port area of 4 to 20 inch valves shall be at least 90 percent of full pipe area.

4. Valves to be designed for 125 psi working pressure.

5. Bodies to be semi steel with raised seats.

6. Seats to have either a welded in overlay of approximately 90 percent pure nickel on surfaces contacting the plug face or shall be bronze conforming to ASTM B 62 and attached to the body by stainless steel set screws.

7. Upper and lower plug stem bushings to be stainless steel and shall be permanently lubricated.

8. Exposed nuts, bolts and washers to be zinc plated.

9. Flanges to be faced and drilled to ASA 125 pound standard.

C. Check Valves

1. Type: Ball Check

2. Ends: Flanged

3. Body: Cast Iron

4. Ball: Hollow steel with vulcanized nitril rubber coating.

5. Pressure Rating: 150 psi

6. Valves shall be suitable for sewage service as required.

7. Valve to be Flygt HDL or equal.

D. Automatic Sewage Air Release Valve

1. The automatic sewage air release valve shall be designed to allow entrapped air to escape from the sewage force main line. After the air escapes out of the air release valve, the valve shall shut off until more air accumulates in it and the opening cycle will repeat automatically.

2. The sewage release valve must have a compound internal linkage of precision molded delrin or stainless steel. All other internals must be stainless steel to positively prevent galvanic action. The float rod shall be 20" long to provide an air gap between the linkage and waste level inside the valve to retard the waste solids from clogging the linkage. The stainless steel float must withstand a minimum 1000 psi pressure. Each valve shall be complete with hose and blow off valves to permit back flushing without dismantling valve.

Body and cover cast iron	ASTM A48 Class 30
Internal Delrin linkage	ASTM D2133 (or Stainless Steel)
Stainless Float	ASTM A240
Buna N	ASTM SB800
Exterior Paint Red Lead	TTP 86 B Type IV

Valve height 28" with back flushing attachments 33 1/2".

If depth of trench is not deep enough, furnish short valve.

Valve height 17½" with back flushing attachments 23 ½".

3. Automatic sewage air release valve to be as manufactured by Crispin, Val-matic, or APCO equal to APCO Model 200A with accessories.

2.04 ACCESSORIES, PLUG AND GATE VALVES

A. Valves to have a two-inch square operating nut unless otherwise indicated.

B. Valves buried in ground or located in vaults or structures to have suitable extensions for socket operation with top of operating nut located six inches below finished grades.

C. Furnish one wrench for each group of two (2) valves having the same service and which can be served from one operating location.

END OF SECTION

SECTION 15301
GATES

PART 1 - GENERAL

1.01 SCOPE

A. The work of this section includes furnishing and installing all gates and gates for the piping systems shown on the drawings, as specified herein or as required for equipment operation. The gates shall be capable of isolating flow from the structure under all conditions without leakage.

1.02 SUBMITTALS

A. The Contractor shall prepare and submit for approval, complete detailed drawings of all gates in accordance with the requirements of the appropriate section of these specifications. All gates of the same type shall be from a single manufacturer. Spare parts shall be furnished as specified under the proposal items. Special tools required for repacking or disassembling gates shall be provided. Contractor shall provide installations and references for gate manufacturer. Engineer shall review documents and approve prior to purchase.

PART 2 – PRODUCTS

2.01 ALUMINUM SLUICE GATES

A. The Contractor shall furnish and install aluminum sluice gates at the outlet structure of the sizes indicated.

B. The gate frames shall be a one piece 1/4 inch 6061 T6 aluminum extrusion with a continuous mounting flange suitable for surface mounting to a concrete wall. The extruded aluminum frame shall be mitered and welded continuously and shall incorporate a one piece extruded polymer channel liner.

C. The gate shall be 1/4 inch aluminum and shall be reinforced to deflect no more than 1/360th of the span. The bottom edge of the gate shall be beveled for positive seating.

D. A cast aluminum handwheel shall be provided and shall work in conjunction with a brass lifting nut and a 1 1/2 inch stain-less steel acme rod. All hardware shall be stainless steel. The lifting nut shall be provided with a grease fitting for ease of lubrication. Polymer bearing pads shall be incorporated above and below the brass lifting nut.

E. The sluice gate assembly shall include a wall thimble to ensure a watertight seal under all operating conditions.

2.01 ALUMINUM STOP/ SLIDE GATES

A. The Contractor shall furnish and install aluminum stop gates at the location shown on the plans of the sizes indicated.

B. The disc shall be aluminum plate ASTM B209 6061-T6 reinforced with structural aluminum shapes or extrusions welded to the plate. The disc shall not deflect more than 1/360th of the span of the gate under the design head.

C. The guide shall be extruded aluminum plate ASTM B221 6061-T6. The guide shall be designed for maximum rigidity and shall have a weight of not less than 3.0 lbs. per linear foot. The guide shall be designed to embed into the face of the concrete and shall provided with keyways to lock them into the concrete.

D. A cast aluminum handwheel shall be provided and shall work in conjunction with a brass lifting nut and a 1 1/2 inch stain-less steel acme rod. All hardware shall be stainless steel. The lifting nut shall be provided with a grease fitting for ease of lubrication. Polymer bearing pads shall be incorporated above and below the brass lifting nut. Stem shall be ASTM A276 Type 304 stainless steel and shall have a rising stem cover of clear polycarbonate with vent holes.

E. The gate assembly shall include a wall thimble to ensure a water tight seal under all operating conditions. Leakage shall be limited to 0.1 gpm per foot of seating perimeter.

F. The seal shall be specifically extruded resilient neoprene mounted to the mounted to the bottom of the disc or installed into the invert member to provide flush bottom closure. The shape of the seal will produce a seating surface having a minimum surface having a minimum width of 314” and the seal shall extend into the secondary slot of the vertical guide.

PART 3 - INSTALLATION

3.01

A. All gates shall be carefully mounted in their respective positions free from all distortion and strain. All gates shall be properly packed and left in satisfactory operating condition at the completion of the project.

3.02

A. Mechanical joints shall be made in accordance with paragraph 3.01 (G) of Section 02555 of these specifications.

3.03

A. Flanged joints shall be made using full-face rubber gaskets 1/8" thick. Bolts and nuts on the gate shall be carbon steel conforming to ASTM A307.

3.04

A. Upon completion of the installation the contractor shall demonstrate that watertight form one side to the other and allows complete isolation of liquid.

END OF SECTION

SECTION 15302
FLOW METERING EQUIPMENT
PARSHALL FLUME

PART 1 - GENERAL

1.01 SCOPE

A. The work of this section involves furnishing and installing a Parshall flume with ultrasonic flow meter.

1.02 SUBMITTALS

A. Shop drawings shall be submitted in accordance with Section 01001, Paragraph 1.17 of these specifications.

B. Operation and maintenance manuals shall be submitted in accordance with Section 01001, Paragraph 1.18 of these specifications.

PART 2 - PRODUCTS

2.01 PARSHALL FLUME

A. The flume shall be a 12" Parshall flume designed to measure flows from .211 MGD to 10.56 MGD. The flume shall be a molded structure of fiberglass reinforced polyester. The interior surface shall have a ten (10) to fifteen (15) mil white ultraviolet-resistant gel-coat backed by a rich layer of resin and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than thirty percent (30%) glass content by weight. The thickness of the walls and floor of the flume shall not be less than one-fourth inch (1/4"); and shall be reinforced with stiffeners down the sides and across the bottom on flumes with a throat width of three inches (3") or greater. The stiffeners shall be joined together at the knee to form a rigid dimensionally stable flume.

B. The flume shall be provided with anchoring clips fastened along the side of the flume to be used for anchorage into the concrete. Stiffeners made of FRP angle/channel shall be provided across the top of the flume to provide structural support during shipping and installation.

C. Flume dimensions shall be in accordance with the United States Department of Interior, Water Measurement Manual, latest revision

D. The flume shall be provided with a head gauge calibrated in tenths of a foot, molded into the side of the flume, at the point of measurement.

2.02 ULTRASONIC FLOW METER (Open Channel Flow)

A. There shall be furnished a recording, totalizing open channel flow meter suitable for portable or fixed-site monitoring. An ultrasonic sensor capable of measuring up to 10' shall be used to measure level. The flow meter shall be programmable for measuring flow based on the type of flow monitoring device installed. Any application requiring level measurements over 10' shall be an ultrasonic flow transmitter along with a controller unit.

B. The sensor shall consist of a single ultrasonic transducer housed in a corrosion resistant 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.

   a. The level measurement span shall be from 0 to 10 feet (0 to 3.05 m) for ISCO or 0 to 39 feet for Rosemount. 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 (0.31 m or less), and ±0.03 feet (±0.009 m) over a head change of 1 to 10 feet (0.31 to 3.05 m).

   b. The sensor cable shall be 25 feet (7.62 m) long. The cable shall terminate in a sealed, military style connector so that the sensor can be easily replaced in the field. [An optional (25 ft. -7.62 m) extension cable shall be supplied.] A stainless steel mounting bracket shall be supplied for mounting the sensor and a sunshade. It shall be possible to suspend the sensor using only the cable.

C. 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. For monitoring in applications using the Manning formula in round, U-shaped, rectangular and trapezoidal channels, the flow meter shall accept information for channel shape and size, and slope and roughness coefficient. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level flow rate polynomial equation.

a. The flow meter shall be connected to tipping bucket rain gauge that tips every 0.01 inch (0.25 mm) or 0.004 inch (0.1 mm) of rainfall.

b. The flow meter shall include an input for a pH probe with a built-in temperature probe, a dissolved oxygen probe and a temperature probe.

c. The flow meter shall be capable of activating a connected sampler based on an AND/OR combination of any two of level, flow rate, rainfall, pH or dissolved oxygen, and temperature.

d. The flow meter shall have a 12 volt pulse output for signaling a connected automatic sampler to collect flow proportioned samples. The flow meter shall have inputs to accept signals from the sampler indicating when a sample is collected and the bottle in which the sample is placed.

e. 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, pH or dissolved oxygen, and temperature in user-selectable units of measure. The totalizer on the LCD shall be resettable. The flow meter shall include a non-resettable, mechanical totalizer. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting.

f. The flow meter shall contain a programmable transmitting unit that will allow output to the SCADA system.

g. The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 6 user-defined partitions. Each partition shall be programmable to store level, flow rate, rainfall, pH or dissolved oxygen, temperate or sample data. 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, flow rate, rainfall, pH or dissolved oxygen and temperature.

h. The flow meter shall have a 4 to 20 mA output proportional to flow rate.

i. The flow meter shall have 2 form C relays with user-selectable trip points based on flow rate.

j. 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.

k. The flow meter shall require 12 volt DC power for operation. Power shall be supplied from a rechargeable lead acid battery with solar panel battery charger.

l. The flow meter shall be housed in a rugged, lockable, watertight, dusttight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing flow data. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

PART 3- EXECUTION

3.01 INSTALLATION

A. Follow all instructions provided by the project engineers in the form of specifications, blue prints, etc.

B. There should be no drops, bends, flow junctions, etc. immediately upstream of the flume location. The flume should be located in a straight section of the open channel.

C. The approaching flow should be uniformly distributed across the channel, tranquil, and subcritical.

D. The approaching flow should not be turbulent, surging, unbalanced, or possessing a poorly distributed velocity pattern.

E. As a general guideline, a straight upstream approach length of 10-20 times the throat width will meet these entrance conditions:
   a. 10 throat widths may be used where the throat width of the flume is larger than half the width of the approach channel
   b. 20 throat widths should be used where the throat width of the flume is less than half the width of the approach channel

F. If baffles are used to correct or smooth the flow, they should be placed upstream of the flume at a distance of at least 10 times the maximum head. Baffles are not recommended for sanitary or solids laden flows.

G. If the crest of the flume (the converging section's floor) is set above the floor of the channel, the channel should rise at a 1:4 slope just before the flume.

H. For channels wider than the entrance of the flume, radius or flat 45° wingwalls should be used to smoothly direct the flow into the flume. Refer to the U.S. Department of the Interior, Bureau of Reclamation's Water Measurement Manual for wingwall radii.

I. 1" and 2" throat width flumes should not be used on sanitary flows.

J. Downstream channels should be straight for 5-20 times the throat width.

    a. Note: Do not use cables or chains to unload flumes. Unload flumes with fabric slings in conjunction with a spreader bar or by lifting eyes (if provided), spreading the load.
    b. The crest of the flume must be set upstream and must be level from front to back and from side to side. A level installation is critical to the proper operation of the flume.

K. Set the flume in place and at the elevation indicated on the engineer's drawings.

L. For larger flumes, concrete piers may be poured perpendicular to the direction of flow for the flume to sit on. Pre-cast concrete blocks may also be used. When piers or blocks are used, the floor of the flume should rest on them and not on the stiffening ribs or flanges.

M. The flume must be secured from flotation. One of the following methods should be used:
    a. Wire should be run from the anchor clips to rebar, or
    b. Rebar should be run through the anchor clips.

    Line the interior of the flume with plywood and brace the flume internally with 2x4's to ensure that the distortion does not occur.

N. Sandbags should be placed inside the flume to prevent it from floating in wet concrete.

O. Grout the flume in place. The first pour should flow from only one side of flume, cover the entire bottom of the flume, and must be allowed to cure before the sidewalls are grouted. Once the first pour has set, grout the sidewalls in 6" (15,24 cm) lifts, letting each lift cure before proceeding.

P. Grout must encapsulate the entire upstream and downstream flanges of flume and be made water-tight.

Q. With large flumes, grout one section between the piers (or blocks) at a time. Due to the distances involved, a grout hose may be required.

R. The use of a vibrator should be minimized as excessive use may bulge or distort the flume sidewalls and bottom. Chaining is recommended in lieu of vibrator sticks.

S. Top bracing should remain attached during operation of flume.

    a. No voids or air pockets should remain in any grout pour. Failure to eliminate voids or pockets will result in settling or bulging of the flume and it not warrantable.

END OF SECTION

SECTION 15501
OPEN CHANNEL GRAVITY FLOW
ULTRAVIOLET ("UV") DISINFECTION EQUIPMENT

PART I – GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and appurtenances required to provide an open channel, gravity flow, low pressure, high intensity ultraviolet lamp (UV) disinfection system complete with an automatic mechanical/chemical cleaning system and variable output electronic ballasts. The UV system to be complete and operational with all control equipment and accessories as shown and specified herein. The system will be capable of disinfecting effluent to meet the water quality standards listed in this section.

B. The ultraviolet disinfection system will be purchased from Trojan Technologies by the Contractor. The system shall be installed by the Contractor and tested and commissioned by Trojan Technologies, as specified in this section. The Owner will consider alternatives if all requirements of this specification are met without exception including Pre-qualification Requirements in section 1.02.

C. The unit(s) shall be furnished with all necessary accessory equipment including but not limited to the UV lamp assemblies, power distribution centers, monitor and/or system controls, automatic Cleaning system as an option if available, lifting system and other auxiliaries, whether specifically mentioned in this Section or not, as required for an installation incorporating the highest standards for the type of service including field testing and instructing the regular operating personnel in the care, operation and maintenance of all equipment.

D. Related work specified elsewhere:

   a. Section 03300: Installing Concrete
   b. Section 05501: Anchor Bolts, Expansion Anchors, and Concrete Inserts
   c. Section 16000: Electrical
   d. Section 05530: Grating
   e. Section 15301: Sluice Gates

E. For purposes of standardization, and to achieve a common operator interface for control systems within the facility, the major items of instrumentation and process control equipment provided for the UV disinfection system local control panels shall be sufficient for full operation. The proposal shall be complete and require only power in accordance with 2.06 to become fully operational.

This equipment shall include but not be limited to system monitor and operator interface devices.

F. The UV system shall be capable of disinfecting existing effluent as well as future flows to meet the water quality standards listed in this Section.

G. Each proposer shall supply a list of at least three comparable installations of current technology within the United States of America.

1.02 QUALITY ASSURANCE

A. Pre-qualification Requirements: Any alternative UV manufacturer that is not named or listed as approved equal must submit the following 15 days prior to bid to be considered for approval:

   a. To be considered, the manufacturer will be regularly engaged in the manufacture of UV systems with a proven track record of at least two hundred (200) operating installations of the proposed UV system.
   b. The manufacturer will provide documentation of previous experience with municipal UV disinfection systems in wastewater applications with variable output electronic ballasts.
   c. Pre-qualification submittals from manufacturers will include a complete and detailed proposal of equipment offered, including the number of lamps proposed and a detailed description of any exceptions taken to the specification.
   d. To be considered, the manufacturer will submit a bioassay evaluation for the proposed reactor, without exception. The bioassay will have been completed by an independent third party and have followed protocols described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003) using MS2 bacteriophage as the surrogate test organism. The bioassay must demonstrate that the proposed UV system design and number of lamps will deliver the specified dose.
   e. Independent certification of fouling factor and lamp aging factor must be submitted if values other than the specified default values are being proposed.
   f. Documentation of UV manufacturer's service capabilities including location and experience.
   g. Sample disinfection performance guarantee including scope and duration of guarantee.
   h. All UV manufacturers will be required to pre-qualify unless the manufacturer is the base bid manufacturer.

1.03 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted for approval in accordance with the Request for Proposal. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all details of dimensions and construction of the UV system and installation details of all equipment.

3. Detailed schematic and layout drawings and a description of operation of all control panels.

4. Descriptive information including catalogue cuts and manufacturers' specifications for all major components.

5. All interconnections and interface requirements, dimensions, and locations of all major elements of the UV system including critical clearance requirements.

6. Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.

7. Independent bioassay validation and dosage calculations demonstrating compliance with the specified dose requirements.

8. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design and that it will conform to the requirements of Paragraph 1.05D.

9. The startup/performance testing report, disinfection performance guarantee, and manufacturer's certification as required in Part 3.

10. Complete operation and maintenance manuals shall be submitted. The manuals shall recognize that UV disinfection technology is not common knowledge to most plant operators, so the manuals shall be thorough and instructive to such personnel. O&M manuals shall be delivered 2 weeks before delivery of system.

1.04 SYSTEM STARTUP

A. The ultraviolet light system supplier shall provide a representative for startup services once the installation is complete.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and is expected to operate as expected.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the UV disinfection system. The instruction shall include classroom training on UV technology, and field training on proper operation and maintenance procedures, along with complete demonstrations of same.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The manufacturer's representative shall provide minimum services in accordance with the following table:

Purpose	**No. of Days**
Installation Supervision	As required of proper installation
Functional Testing	2
Performance Testing	3
Operator Training	1

5. The number of days indicated above shall be provided on an 8-hour-day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF THE SYSTEM

A. The equipment specified herein shall be low or medium pressure, low or high output ultraviolet light disinfection equipment designed to reduce the fecal coliform micro-organisms of a domestic wastewater treated to secondary standards utilizing aerated lagoon and constructed wetland treatment system with influent characteristics as specified in Paragraph 1.05B so that the final effluent shall meet the effluent discharge conditions as specified in Paragraph 1.05D. The UV system shall be hydraulically rated for at least 0.7 mgd peak flow.

B. Influent Characteristics to Disinfection Channels

1. The UV disinfection system shall be designed to disinfect an influent at the flow rates and with the characteristics as shown below.

a. Peak Hour Flow (mgd)	3.0 MGD
b. Peak Daily Flow (mgd)	2.0 MGD
c. Average Flow (mgd)	1.0 MGD
d. Total Suspended Solids (mg/l)	30 mg/L
e. 5-day B.O.D. (mg/l)	30
f. UV Transmittance at 253.7 nm	65% minimum
g. Annual Effluent Temperature Range	33° to 85° F
h. Effluent Standards to be Achieved	200/100 ml fecal coliform, based on 30 day geometric mean of daily samples for the effluent standard as specified in a) through g). Effluent standards will be guaranteed regardless of influent count to the UV system.
i. Validation Factors	0.98 end of lamp life factor 0.95 fouling factor
j. Redundancy	1 UV Bank at ADF of 1.0 MGD

C. UV Channel Configuration

1. The system shall be installed in one (1) open channel having the characteristics shown on the attached Drawings.
2. The minimum design requirements of the UV system supplied shall be as follows:

<u>Channel</u>

a. Number of UV Channels at each site	1
b. Approximate Channel Length Req.	25 ft 4 in
c. Channel Width for No. of UV modules	12 in
d. Channel Depth	46 in
e. Minimum effluent depth	14.55 in

UV Modules

f.	Number of UV banks per channel	2
g.	Number of UV lamp modules per bank	3
h.	Number of lamps in each UV lamp module	4
i.	Total number of lamps	24
j.	Maximum Power Draw	9 kW

UV Panels

k.	Power Distribution Center	2
l.	UV Detection Systems	2
m.	System Control Center	1

Misc. Equipment

n.	Level Controller	1
o.	Lever Controller Type	Fixed Weir
p.	Auto Chemical Cleaning	ActiClean WW™ or approved equal
q.	UV Module Lifting Device	Davit Crane
r.	Standard Spare Parts	Included

s. Minimum and maximum water levels above channel floor shall be specified as part of the proposal

These requirements are considered minimum. Each supplier shall present the specific number of units proposed for his installation.

D. Bacteriological Inactivation Requirements

1. Flow Characteristics
   a. Number of channels in service 1
   b. Total average flow (mgd) Initial= 1 mgd

2. Fecal Coliform Testing Criteria
   a. 30-day geometric mean of daily samples 200 per 100 ml

3. Grab samples of the influent to and effluent from the UV disinfection system shall be collected during the performance testing period specified in Part 3 of this Section. The samples shall be tested for fecal coliform content in accordance with the procedures recommended in "Standard Methods."

E. Performance Requirements:

1. The UV system will be designed to deliver a minimum UV dose of 30 mJ/cm2 at peak flow, in effluent with a UV Transmission of 65 % at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the UV dose delivered by the UV system will be the independent third party bioassay, without exception. Bioassay validation methodology to follow protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003) using MS2 bacteriophage as the surrogate test organism.

2. The UV Dose will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analyzed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

3. The UV Dose will be adjusted using a quartz sleeve fouling factor of 0.8 when sizing the UV system in order to compensate for attenuation of the minimum dose due to sleeve fouling during operation. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected and analyzed in accordance with protocols described in NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (May 2003).

4. Independent Validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer a minimum of fifteen (15) days prior to bid.

5. The system will be able to continue providing disinfection while replacing UV lamps, quartz sleeves, ballasts and while cleaning the UV lamp sleeves.

6. The system will be designed for complete outdoor installation.

1.06 MAINTENANCE

A. Spare parts shall be provided with the UV disinfection system. The parts shall not be consumed by the manufacturer or Contractor and shall be in the hands of the Owner upon Substantial Completion. The parts shall be provided in sturdy containers, labeled on all sides with information concerning the contents and suitable for long term storage in a room without environmental controls.

B. Spare Parts

The following spare parts shall be provided:

1. Four (4) UV Lamps
2. Four (4) Lamp Sleeves
3. Four (4) Lamp Holders

C. Operators Kit:
The following items will be furnished:

1. One (1) face shield to protect operator from UV light.
2. One (1) gallon of cleaning solution. (Lime-A-Way manufactured by Ecolab or approved equal)

1.07 WARRANTY

A. The equipment furnished under this section will be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of 12 months from date of start-up or 18 months after shipment, whichever comes first.

B. The UV lamps shall be warranted for a period of 12,000 hours at full power when in automatic mode, prorated after 9,000 hours. On/off cycles are limited to four (4) per day.

C. Ballasts to be warranted for 5 years, prorated after 1 year.

PART 2- PRODUCTS

3.01 MANUFACTURER

A. The physical layout of the system shown on the contract drawings and the equipment specified herein are based upon the UV3000Plus™ System, as manufactured by Trojan Technologies, London, Ontario, Canada.

B. If other equipment is proposed, the Contractor will demonstrate to the Engineer and the Owner that all requirements of materials, performance, and workmanship have been met or exceeded by the equipment proposed. Contractors proposing alternate manufacturers will be responsible for all costs associated with system evaluation and redesign including all electrical, mechanical and civil aspects of the installation.

3.02 DESIGN, CONSTRUCTION, AND MATERIALS

A. General:

1. All module welded metal components in contact with effluent will be Type 316 stainless steel.

2. All metal components above the effluent will be Type 304 stainless steel with the exception of the ballast enclosure, which is constructed of anodized aluminum.

3. All wiring exposed to UV light will be Teflon™ coated.

4. All wires connecting the lamps to the ballasts will be enclosed inside the frame of the UV Module and not exposed to the effluent. To be considered as an alternate, wires that are exposed to the effluent will be warranted for 15 years and will be Teflon™ coated to prevent degradation under constant exposure to UV light.

B. Lamp Array Configuration:

1. The lamp array configuration will be the uniform array with all lamps parallel to each other and to the flow.

2. The system will be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent.

C. UV Module:

1. Each UV module will consist of four (4) UV lamps with an electronic ballast enclosure mounted on a Type 316 stainless steel frame. To be considered as an alternate, ballasts housed in a separate enclosure located external to the channel will be equipped with a suitable air conditioning system, supplied by the UV manufacturer, to maintain internal enclosure temperatures below 80°F (26°C). No forced air ventilation will be allowed.

2. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal. To be considered as an alternate, lamp quartz sleeves that are open at both ends will be supplied with twice the amount of specified spare seals and lamps.

3. The closed end of the quartz sleeve will be held in place by means of a retaining O-ring. The quartz sleeve will not come in contact with any steel in the frame.

4. The ends of the lamp sleeve will not protrude beyond the stainless steel frame of the UV Module.

5. Lamp wires will terminate in the electronic ballast enclosure located at the top of the UV Module.

6. All lamp to ballast connections will be made by and tested by the UV Manufacturer.

7. The electronic ballast enclosure will contain the electronic ballasts and addressable lamp status monitoring systems.

8. Each UV Module will be connected to a receptacle on the Power Distribution Center.

9. At the point of exit from the UV Module frame the multi conductor cable will pass through a waterproof strain relief.

10. Each UV module will have a rating of Type 6P.

D. Ultraviolet Lamps:

1. Lamps will be high intensity low pressure amalgam design. The lamp will be preheated to promote longevity. Lamps that are not amalgam or that are based on driving a low pressure lamp at amperages greater than 500 milliamps will not be allowed.

2. The filament will be of the clamped design, significantly rugged to withstand shock and vibration.

3. Electrical connections will be at one end of the lamp and have four pins, dielectrically tested for 2,000 Vrms. Lamps that do not have 4 pins will be considered instant start. To be considered as an alternate, instant start lamp systems will supply replacement spare lamps equal to 50% of the total number of lamps in the system.

4. Lamps will be operated by electronic ballasts with variable output settings.

5. Changing of lamps and sleeves shall be easily performed by the operating personnel at the plant. Systems whereby the lamp assemblies have to be returned to the factory for lamp replacement will not be allowed.

6. The UV lamps in the UV reactor should be submerged at all times to prevent overheating and UV equipment damage. This is accomplished by installing the UV reactors at an elevation below the hydraulic grade line elevation and

maintaining submersion by installing a flow control weir downstream of the UV reactor.

E. Lamp End Seal and Lamp Holder:

1. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal and holder.

2. The open end of the lamp sleeve will be sealed by means of a sleeve nut which threads onto a sleeve cup and compresses the sleeve O-ring.

3. The sleeve nut will have a knurled surface to allow a handgrip for tightening. The sleeve nut will not require any tools for removal.

4. The lamp will be held in place by means of a molded lamp holder that will incorporate two seals. The lamp holder will incorporate a double seal against the inside of the quartz sleeve to act in series with the external O-ring seal.

5. The second seal on the lamp holder will isolate and seal the lamp from the module frame and all other lamps in the module.

6. In the event of a quartz sleeve fracture the two seals of the lamp holder will prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.

7. The lamp holder will also incorporate a UV resistant PVC molded stop that will prevent the lamp sleeve from touching the steel sleeve cup.

F. UV Lamp Quartz Sleeves:

1. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.

2. Lamp sleeves will be domed at one end.

3. The nominal wall thickness will be 1.5mm.

G. UV Module Support Rack:

1. The UV module support rack will be minimum Type 304 stainless steel and be mounted above the effluent in the channel allowing adjustment to the precise height of the channel.

H. Effluent Level Controller:

1. Level Control Weir
    a. Located at the discharge end of the UV channel.
    b. Designed to maintain a minimum channel effluent level as required to keep lamps submerged.
    c. Constructed of Type 304 Stainless Steel.

I. Low Water Level Sensor:

1. One low water level sensor will be provided by the UV Manufacturer for each UV channel.

2. During manual, automatic, and remote modes of system operation, the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.

3. The low water level sensor will be powered by the Power Distribution Center.

J. Electrical:

1. Each UV module within a bank will be powered from the bank's dedicated Power Distribution Center.

2. UV manufacturer to supply all cabling and conduit between lamps and ballasts.

3. UV manufacturer to perform all terminations between lamps and ballasts.

4. Each electronic ballast within a UV module will operate two lamps.

5. Power factor will not be less than 98% leading or lagging.

6. Electrical supply to each Power Distribution Center will be 480/277V 60Hz,3.20 kVA.

7. Electrical supply to the Hydraulic System Center will be 480V 60Hz, 2.5 kVA.

8. Electrical supply for the water level sensor will be provided by the PDC and be 12 Volt DC.

9. Electrical supply to the System Control Center will be 120V 60Hz, 0.15 VA.

Note to Specifier: The UV System electrical panels are not provided with electrical disconnects. Each electrical power supply should be provided with a separate disconnect to be supplied under the electrical contract.

K. Power Distribution Center:

1. Power distribution will be through environmentally sealed receptacles on the PDC(s) to allow for local connection of UV modules.

2. Data concentration will be through integrated circuit boards located inside the Power Distribution Center.

3. PDC enclosure material will be Type 304 Stainless Steel - Type 4X (IP66).

4. All internal components will be sealed from the environment.

5. All Power Distribution Centers to be UL listed and UL listed to Canadian safety standards or equivalent with a rating of Type 4X.

6. One separate sealed Power Distribution Center will be provided per bank of lamps.

7. To be considered as an alternative, systems that have ballasts mounted in cabinets, the UV manufacturer will provide one complete cabinet for each bank of lamps, to ensure that each bank is electrically isolated for safety during maintenance and to provide redundancy under average flow conditions.

   Note to Specifier: If the System Controller is installed outdoors, it is recommended that the operator interface side be positioned away from direct sunlight.

L. Control and Instrumentation:

1. System Control Center (SCC):

   a. A submersible UV sensor will continuously monitor the UV intensity produced in the bank of UV lamp modules. The sensor will measure only the germicidal portion of the light emitted by the UV lamps.

   b. UV intensity in mW/sq.cm will be indicated on a 3 character display.

   c. Elapsed time in hours will be indicated on 5 character display.

d. Both displays will utilize 7 segment LEDs and will be visible through the panel door.

e. A dry contact will be provided for Low UV intensity alarm.

f. Monitoring System will be enclosed in fiberglass Type 4X wall mounted panel.

g. To be located less than twelve (12) feet from the UV Module (LED end).

h. A SCADA output consisting of Allen Bradley PLC shall be provided.

i. Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include but not be limited to:
    i. Lamp Failure
    ii. Multiple Lamp Failure
    iii. Low UV Intensity
    iv. Module Communication Alarm

j. The 100 most recent alarms will be recorded in an alarm history register and displayed when prompted.

k. Bank status will be capable of being placed either in Manual, Off or Auto mode.

l. Elapsed time of each bank will be recorded and displayed on the display screen when prompted.

m. Optional: Digital I/O modules will be provided to remotely indicate status and alarms such as:
    i. Alarm conditions (major, critical)
    ii. Bank status (one for each UV bank supplied)

M. UV Detection System:

1. A submersible UV sensor will continuously monitor the UV intensity produced in each bank of UV lamps.

2. The sensor will measure only the germicidal portion of the light emitted by the UV lamps. The detection system will be factory calibrated. Detection systems that can be field calibrated will not be permitted.

N. Dose-Pacing:

1. A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from an effluent flow meter (by Others).

2. The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.

3. The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV bank ON/OFF cycling.

O. Hydraulic System Center (HSC):

1. One (1) HSC will be supplied to house all components required to operate the automatic cleaning system.

2. Enclosure material of construction will be Type 304 Stainless Steel - Type 4X (IP66).

3. The HSC will contain a hydraulic pump complete with integral 4-way valve and fluid.

P. Cleaning System:

1. An automatic cleaning system will be provided to clean the quartz sleeves using both mechanical and chemical methods. Wiping sequence will be automatically initiated with capability for manual override.

2. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.

3. Cleaning cycle intervals to be field adjustable.

4. Remote Manual and Remote Auto cleaning control options will be provided.

5. The cleaning system will be provided with the required solutions necessary for initial equipment testing and for equipment start-up.

6. To be considered as an alternate, systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. Contactor will be responsible for installation.

Q. Module Lifting Device:

1. One Davit crane, base and lifting sling will be supplied to assist in removing individual modules from the effluent channel.

2. Lifting device will be a crane with hand winch and will include an adjustable boom to ensure adequate reach and height.

3. Lifting device to include a swivel handle for rotation and positioning.

4. Crane and base will be supplied by the Manufacturer and will be installed by the Contractor.

R. Spare Parts:

The following spare parts and safety equipment to be supplied.

1. 4 UV Lamps
2. 4 Quartz Sleeves
3. 4 Lamp Holder Seals
4. 1 Operators kit including face shield, gloves, and cleaning solution.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The City of Folkston will obtain a qualified contractor to install the ultraviolet system in strict compliance with the manufacturer’s instructions and recommendation.

B. In accordance with contract drawings, manufacturers' shop drawings, instructions and installation checklist. Contractor Installation Checklist to be completed and returned at least two (2) weeks prior to date requested for commissioning. Photographs illustrating site readiness are required. The Contractor assumes all responsibility for the installation readiness of the UV system.

C. All labor, materials and test apparatus necessary for completing the installation shall be furnished by the Contractor at no additional cost to the Manufacturer.

3.02 MANUFACTURER'S SERVICES

A. Installation assistance only provided if in scope.

B. Start-up and field testing: Start-up and Field Services will only be schedules upon written request. Contractor shall notify Trojan of schedule requirements at least ten (10) working days in advance. Upon arrival to commission the equipment, if the Trojan's Certified Service Technician determines the Contractor work is not complete and the start-up cannot be completed in the allotted time. A return visit will be scheduled at the Contractors expense. Contractor will issue a change order or purchase order for the return trip and additional time required.

C. Operator Training: Contractor responsible to schedule the training during the commissioning time allocated. If trainees are not available a return visit will be scheduled at the Contractors expense.

D. Warranty Service: As outlined in warranty agreement.

3.03 GENERAL TESTING REQUIREMENTS

A. The manufacturer shall furnish the services of a factory trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements. If the system fails to meet specified requirements, it shall be adjusted, repaired, and/or replaced at no additional cost to the Owner.

3.04 FUNCTIONAL TESTING

A. Prior to startup, a manufacturer's representative shall inspect the installed UV disinfection system for proper alignment, correct operation, proper connection, and satisfactory function of all components, including ground fault circuit interrupters and a safety inspection of wet cable connectors. The manufacturer's representative shall approve the installation and provide certification that the system components have been installed correctly and are ready for operation.

B. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer prior to scheduling and performing the functional test.

3.05 PERFORMANCE TESTING

A. Tests shall be performed by an Independent Certified Testing laboratory. Testing shall commence after installation and start-up of the UV system. Samples will be collected at times when the flow through the plant is at or near the peak flow rating of the UV system.

1. The samples collected shall be analyzed for the following, using standard testing procedures.

    a. Fecal coliform count just prior to disinfection.
    b. Fecal coliform count just after disinfection.
    c. Suspended solids prior to disinfection.
    d. BOD5 prior to disinfection.
    e. Percent transmission at 254 nm prior to disinfection.

2. The duration of the performance testing shall be three days and the frequency of sample collection will be three times per 24 hour period at intervals directed by the Owner. The data obtained shall be recorded and included in the formal test report.

B. Analytical Method. Test and sample preservation methods for test contaminants shall be in accordance with the latest revisions of AWWA Standards Method for Examination of Water and Wastewater.

C. An allowance for testing shall be included in the proposal.

END OF SECTION

SECTION 15512
SLUDGE DEWATERING SYSTEM
BELT PRESS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The Belt Filter Press furnished under this contract shall comply with the following performance requirements and specifications which are based upon time proven design. That design combines high strength structural integrity, extensive material longevity, minimal maintenance and utility requirements, and state of the art process resulting in superior overall performance.

B. Equipment furnished and installed 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 noted by the engineer.

1.02 SYSTEM DESCRIPTION

A. The Tower Belt Filter Press furnished under this contract shall feature a vertical arrangement of pressure rollers that permits 205 degree minimum wrap on each roller.

B. The sludge dewatering system shall consist of a skid mounted belt filter press with slurry feed pump, washwater pump, and polymer conditioning system, and includes all necessary controls, piping and wiring to provide a turnkey system.

1.03 QUALITY ASSURANCE

A. System Responsibility: Vested responsibility for operation and control of the BFP system, which is comprised of all equipment controlled by the BFP control panel, is the BFP manufacturer's.

B. Experience Qualification: BFP equipment shall be provided by a manufacturer who is qualified and experienced in the production, installation, operation, and process control of dewatering polymer, conditioned, aerobically digested sludge dewatering polymer, conditioned sludge from municipal wastewater treatment facilities. A qualified manufacturer is one having a minimum of ten (10) units of the proposed model, each having been in operation for a period of not less than five (5) years.

C. The belt filter press manufacturer is to have a minimum 20 years of development, assembly and manufacturing experience. No exceptions to this requirement shall be accepted.

D. Equipment submitted for approval which does not meet the specified experience period shall be considered only if the Contractor provides a bond or certified check which shall guarantee replacement in the event of failure to comply with all other criteria contained in the procurement documents. The amount of the guarantee bond or certified check shall be for 200% of the full bid price of the equipment. The period of time for which the guarantee bond or certified check is required shall be equal to the experience period specified.

E. Source Quality Control: The belt filter press shall be designed, fabricated, assembled, and tested by the belt filter press manufacturer in their own facility. In order to provide maximum quality assurance, all aspects of the design, fabrication, and assembly, shall be performed by personnel employed by the manufacturer. The belt filter press manufacturer shall at the same facility maintain a suitable spare parts inventory. Prior to shipment, the belt filter press and control panel shall be factory tested as described in section 3.01.

1.04 PATENTS

A. The manufacturer warrants that the use of this system and its equipment, in the process for which the system has been expressly designed, will not infringe any U.S. or foreign patents or patents pending. In the event of any claim of infringement the manufacturer shall defend and indemnify the owner free from any liabilities associated with the use of the patented equipment or process.

B. The manufacturer hereby grants to the owner, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending, owned, or controlled by the manufacturer in the operation of the facility being constructed in conjunction with the equipment supplied under this contract, but without the right to grant sublicenses.

1.05 MANUFACTURER'S WARRENTY

A. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of twelve (12) months from the date of startup, not to exceed eighteen (18) months from the date of delivery, unless noted otherwise within the specifications.

1.06 CONDITIONS OF SERVICE

A. The sludge dewatering equipment shall be designed to adequately condition and dewater the sludge so that a dewatered sludge cake is produced that easily discharges from the dewatering unit without blinding and that may be handled by the pump or conveying equipment.

B. Each unit shall be designed to operate in the environment for which it is intended, continuously or intermittently on demand, and shall perform the required dewatering operations without spillage of water or sludge beyond the nominal machine envelope.

C. The alternate bid manufacturer and Contractor shall absorb all costs associated with changes in layout, piping, controls, electrical wiring, etc. (including engineering costs) if the alternate bid manufacturer is accepted.

1.07 PERFORMANCE REQUIREMENTS

A. Each belt filter press shall be capable of meeting the following minimum performance criteria provided the above Conditions of Service are furnished:

Sludge throughput, lbs. d.w.s./hour	400-1000
Hydraulic capacity, gpm.	30-100
Cake solids, percent d.w.s.	13-18%
Solids capture, percent	93-95%
Polymer consumption lbs./ton of active polymer in feed, d.w.s.	6-10

PART 2 – PRODUCT

2.01 DESIGN CRITERIA

Number of belt filter presses required:	1
Model Manufacturer:	Charter Machine Company or approved equal
Model Number:	TP 12.43
Belt Width Minimum:	1.2m
Width Overall:	6’-9”
Length Overall:	21’-3”
Height Overall:	8’-3”

2.02 MATERIALS OF CONSTRUCTION

A. All materials used in the construction of the sludge dewatering equipment shall be of the best quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM Standard Specification for Structural Steel, Designation A36/A36M. All iron castings shall conform to the ASTM Standard Specifications for Gray Iron Castings, Designation A48, and shall be of a class suitable for the purpose intended. All structural carbon steel plates and shapes shall have a minimum thickness of 1/4 inch and shall be hot dip galvanized in accordance with ASTM A-123

B. The following materials and coatings shall be provided for the belt filter press and related components unless specified otherwise herein:

Main Frame	Box frame of welded and bolted MC channels conforming to ASTM A36, then hot dip galvanized according to ASTM A123
Flocculator	Type 304 stainless steel and UHMW polyethylene.
Wash Box	C.S. Galvanized, fitted with U.H.M.W. polyethylene wiper bars.
Perforated Roller	Carbon steel, hot dip galvanized according to ASTM A123.
Drive Rollers	Carbons steel coated with 3/8” thick synthetic rubber, 60 durometer.
Tracking Rollers	Carbon steel coated with 3/8” thick synthetic rubber, 60 durometer.
Other Rollers	Carbon steel coated with 20 mil Rilsan II Nylon.
Sludge Plows	Polyethylene.
Bearings	Double row spherical roller type.
Bearing Seals	Quadruple lip contact seals with gasketed cast iron end caps.
Pneumatic Cylinders	200psi rating, anodized aluminum tube with stainless steel tie rods, Teflon seals, graphite bearing, lubrication not required.
Belt Tracking	Fully pneumatic analog.
Belt Tensioning	Fully pneumatic.

Belt Wash Stations	Hand wheel operated internal brush type with stainless steel manifold, valve, nozzles, brush, aluminum handwheel, and type 304 stainless steel enclosure with neoprene seals.
Belts	Monofilament polyesyer weave selected for function and particular sludge. Seams are 316 stainless steel clipper type.
Filtrate Pans	Type 304 stainless steel.
Sludge Chutes	Type 304 stainless steel.
Cake Discharge Chute	Type 304 stainless steel.
Water Plumbing	PVC, schedule 80
Pneumatic Plumbing	Polyethylene tubing, 120psi work, 625psi burst.
Doctor Blades	UHMW polyethylene.
Junction Box	NEMA 4X type 304 stainless steel
Pneumatics Station	NEMA 4X type 304 stainless steel.
Assembly Hardware	Type 304 stainless steel

2.03 BELT FILTER PRESS MAIN FRAME

A. Main frame design is crucial as it is the support structure of the entire machine. The main frame shall be a box frame of welded and bolted MC channels conforming to ASTM Specification A36 and designed to accommodate all operating and static loads without significant deflection, deformation or vibration. Maximum operational loading shall be defined as the sum of the belt tension load based on a belt tension of 50 pli; friction loads; roller, equipment and sludge loads; any loads induced by the belts; and any loads induced by the torque of the drive. The pressure zone main beams shall have a moment of inertia of at least 60 inches to the fourth power. The frame safety factor shall be greater than 7.1.

B. Main frame coating is crucial to the protection of the press main frame. All frame members shall be prepared and coated according to ASTM A123, hot dip galvanized to a minimum 5 mil thickness. All frame members shall be drilled and machined, and all bolted connections shall be disassembled prior to galvanizing.

2.04 FLOCCULATOR

A. The belt filter press shall be furnished with an upstream sludge-conditioning device consisting of an inline adjustable orifice venturi type mixer complete with polymer injection device. The mixer shall be designed to condition the sludge with polymer to result in a degree of flocculation that will produce the greatest amount of dewatering while maintaining the highest quality filtrate.

B. Equipment includes, mixing system, metering pump, check valve, rotameter, pressure gauges all mounted on 304 stainless steel frame which will be bolted to the equipment skid system. Control features include NEMA 4X FRP control panel designed to accept 120 VAC / 60Hz / single phase.

C. Location of the flocculation device will vary with the application. Several locations may be specified with the unused locations plumbed with spool pieces. The assembly shall consist of a flow splitting manifold, a four port vortex polymer injection ring, an in line, non clog, variable orifice mixer and all the necessary piping to complete the system. Polymer addition systems which utilize tanks with mixers or inject polymer directly into the sludge line are not an acceptable equal to the system specified due to the excess amounts of polymer required by these inefficient systems.

D. The sludge conditioning system shall be capable of providing the following performance:

    a. The polymer and sludge must be instantly mixed (less than 1.0 second at 60 GPM).
    b. Mixing energy must be independently adjustable during operation

E. The polymer mixer shall be designed specifically for its intended use. The use of modified check valves, static mixers, or mixers requiring a tank and motor driven propeller shall not be acceptable to this specification.

2.05 GRAVITY DEWATERING ZONE

A. The gravity-dewatering zone shall consist of an extending horizontal belt with neoprene sealed sidewalls. Sludge shall be distributed on the horizontal belt through a stainless steel head-box. A series of eleven (11) rows of plows shall be arranged along the sludge path to achieve maximum drainage of free water from the sludge. The thirty-nine (39) individual sludge plows shall be constructed of polyethylene. Belt press manufacturers' whose gravity deck height exceeds 72" (as measured from the base plan of the press frame to the top of the plot assembly), shall supply an elevated walkway with safety handrails and access stairs along three (3) sides of the press.

B. The complete sludge plow assembly can be raised away from the filter belt for cleaning purposes by operating a 4-way pneumatic hand valve. The free-floating, individual plows shall ride on the belt. Each individual plow shall be replaceable without disassembly and removal of the plow grid, and without the use of hand tools in under 2 seconds.

C. Sludge from the upper gravity area shall be distributed onto the lower horizontal belt by a baffled type 304 stainless steel chute.

D. Midway through the lower gravity area, an adjustable stainless steel sludge leveling bar shall evenly apply the sludge across the full belt width.

E. The gravity belts shall be supported by rollers and a grid of high-density polyethylene wear bars.

F. The minimum effective dewatering area of the upper and lower gravity dewatering zones shall be, 53 square feet as measured along a single belt.

2.06 WEDGE ZONE

A. The wedge zone shall be provided in order to gently apply and gradually increase the pressure on the thickened sludge. The wedge zone shall consist of a wedge-shaped toller and adjustable grid formation in which the two belts gradually converge to form the cloth/cake sandwich. Support for the filter belt shall be by rollers and a grid of high-density polyethylene wear bars. The minimum effective dewatering area of the wedge zone shall be 33 square feet as measured along the lower belt.

2.07 HIGH PRESSURE/SHEAR ZONE

A. Each belt filter press shall be furnished with a pressure section following the gravity drainage section. The pressure section shall consist of two stages.

B. The first stage of the pressure section shall be the increasing pressure (wedge) zone, where the upper and lower belts gradually converge with the sludge between the belts. In the wedge zone the sludge cake is prepared for the shear pressure zone by generating continuously increasing pressure on the sludge as it travels through the zone.

C. The minimum effective dewatering area in the increasing pressure shall be 9.7 square feet. Grids as defined in the materials of construction section shall support the belt in the increasing pressure zone.

D. The wedge zone shall utilize horizontal support bars to give a wiping action to the bottom of the belt that will quickly remove water allowing faster drainage. The belt-

supporting grid in the wedge zone shall be horizontal and blend into a gradual downward curve that shall be tangent to a radius pressure grid.

E. The second stage of the pressure section shall be the shear pressure zone consisting of radius curved grids and rollers arranged to provide an S shaped pattern of belt travel. The curved grids shall enhance dewatering by causing the pressure on the sludge between the belts to increase and press out free water.

F. The minimum effective dewatering area in the pressure zone shall 38.1 square feet. The effective dewatering area in the shear pressure zone shall be defined as the area of the two (2) pressure grids and the five (5) rollers in contact with the belts.

2.08 CAKE DISCHARGE ZONE

A. Adjustable pneumatically loaded doctor blades shall be mounted at the discharge rollers for removing sludge cake from both belts. The doctor blades shall be power retractable and can be held away from the filter belts for cleaning and maintenance. The amount of pressure the doctor blades exert equally against both belts can be varied while the machine is operating. The adjustment of the doctor blades can be regulated from a pneumatic control panel located on the press.

B. The doctor blades shall be made from UHMW polyethylene. The blades shall be rigidly reinforced to provide even gentle pressure on the belts with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring the seam.

C. A 14-gauge type 304 stainless steel chute shall be provided for directing the sludge to the next destination.

2.09 ROLLERS

A. All rollers shall be designed for a maximum deflection of 0.004” at mid span under maximum loading conditions. Maximum loading shall be defined as the sum of the belt tension load at 50psi; friction loads; equipment and sludge loads; any loads induced by the elasticity of the belts; and any loads induced by the torque of the drive. Minimum roll safety factor shall be 7.9.

B. The perforated drum shall be of through shaft design with internal bulkhead and matched deflection of shaft and end plates. All other rollers shall be of stub shaft design with each stub secured by an end plate and an internal bulkhead. Assembly of rollers, shafts, end plates, and bulkheads shall be of machined concentricity and by means of continuous weld.

C. Drive rollers shall be coated with a minimum 3/8" thick synthetic rubber of 60 durometer to provide the friction required for efficient belt drive and tracking. All other solid rollers shall be coated to the point of insertion of the bearing with Rilsan Nylon II to a thickness of 25 mil by the Electro Static, Fusion Bonded Rilsan Powder Dispersion Process.

D. The perforated drum shall be hot dip galvanized to a minimum thickness of 5 mil and shall be totally free of projections that may shorten belt life.

E. The pressure rollers shall be arranged vertically on alternating sides of the main pressure channel. The diameters of the rollers starting with the perforated roll shall decrease in size up through the vertical stack to the first of five 10 ¾" diameter rolls, with each roller separately pan drained to prevent rewetting of the sludge on the preceding rollers.

2.10 ROLLER BEARINGS AND SEALS

A. Roller bearings shall have an L-10 rating greater than 2,750,000 hours per AFBMA test procedure under maximum loading conditions as the sum of the belt tension load at 50psi and calculated at a belt speed of 5 meters per minute. All bearings shall be greaseable with all grease fittings located for servicing from the machine exterior. All roller bearings shall be double row spherical roller type. All bearings shall have quadruple lip contact seals.

B. All bearing housings shall be class 30 cast iron one-piece pillow block type with bolted end cap as manufactured by Charter Machine Company or approved similar. Bearing housings shall be coated by a two part epoxy base coat primer of four (4) mil dry film thickness and two (2) finish coats of two part epoxy at four (4) mil per coat dry film thickness.

C. All Tower Press roller bearings shall be guaranteed for five (5) years.

2.11 PNEUMATIC CONTROL SYSTEM

A. All belt press pneumatic system controls, belt tensioning, tracking, doctor blade, and sludge plow grid controls shall be frame mounted on the belt press in a 304 S/S NEMA 4X enclosure. Belt and doctor blade tensioning adjustments, sludge plow grid adjustments, low air alarm switch, and tensioning valves for on/off control shall be mounted inside the enclosure. Belt and doctor blade tensioning on/off, tension gauges, and plow grid lift levers and adjustment controls shall extend through the enclosure for easy access. The enclosed controls shall be preceded by an oil coalescing filter and a

three (3) micron air filter regulator with gage. One (1) 1/2" female NPT supply air connection shall only be required to the total pneumatic system. Lubrication of the pneumatic system shall not be required.

B. Each belt press shall be furnished with a receiver mounted single stage air compressor. The unit shall be complete with 17 gallon ASME Code receiver rated for 200 psi, pressure gauge, automatic overload protector, intake air filter-muffler, pressure switch, safety valve, tank drain, outlet valve, and constant speed regulator. The motor shall be 1.5 HP, TEFC with 1.15 service factor.

C. The hydraulic oil filter shall be a washable 10-micron screen that does not require frequent replacement but can be cleaned by washing.

2.12 BELT TENSIONING

A. Belt tensioning shall be maintained pneumatically and controlled from the press mounted pneumatic control center.

B. Each filter belt shall be tensioned by a pair of noncorrosive pneumatic cylinders attached to a rigid tensioning assembly. The tensioning assembly shall be attached to each tensioning cylinder in such a way as to assure parallel movement of the tensioning roller.

C. Each belt shall be tensioned individually, with capability of changes with the machine operating. Tensioning pressure shall be gauged at the pneumatic control center. Tensioning cylinders shall be power retractable for belt replacement and emergency de-tensioning.

D. The tensioning arrangement shall accommodate a minimum of ±2% increase in belt length throughout the anticipated belt life.

2.13 BELT TRACKING

A. Belt tracking shall be totally pneumatic and shall function as a continuous automatic belt guidance system. Each belt shall be tracked individually by a type 304 stainless steel paddle arm and analog system sensor which monitors one edge of the belt and pneumatically signals a noncorrosive pneumatic cylinder for corrective positioning when required. That corrective motion shall be smooth, minimal, and adjustable.

B. Each belt tracking assembly shall be center pivoting complete with bearings to minimize dewatering belt stretch and wear.

2.14 BELT WASH STATIONS

A. Each filter belt shall be equipped with a belt wash station for constant belt washing. Each station shall include a manifold with removable stainless steel nozzles, internal hand wheel operated brush, hand wheel operated flush valve, and stainless steel neoprene skirted enclosure for containing spray mist. Belt spray water and flush water shall be collected in stainless steel pans and plumbed to the base sump to prevent rewetting of sludge process. Spray nozzles shall be suitable for use with non-potable plant effluent water.

B. The belt wash station shall extend beyond the full width of the filter belt by a minimum of two (2) inches per side. The belt wash system shall be suitable for use with plant effluent water with a maximum suspended solids content of 50 mg/l. The belt wash system shall be designed to operate at the minimum flow of 40 gallons per minute, and at a minimum pressure of 85 psig.

C. A 1.5HP washwater booster pump shall be provided and neatly installed near the belt press. The pump shall be centrifugal type with replaceable wear rings and shall be plumbed into the belt wash system by the Contractor. The station has an existing automatic telephone dialer system. The existing system must be protected. The Contractor shall re-use the existing automatic dialer system for the new pump station.

2.15 FILTER BELTS

A. Filter belts shall be of polyester monofilament woven ware with minimum tensile strength of 890 pounds per lineal inch. Edges shall be chamfered and belt seams shall be type 316 stainless steel clipper type. Mesh shall be selected for optimal pressure dewatering of the pertinent sludge. Belts shall be self-threading under power for replacement.

B. Replacement of filter belts shall be accomplished without any disassembly of any part of the belt filter press except the belt joints.

2.16 AUTOMATIC TELEPHONE DIALER (EXISTING):

A. The dewatering system shall utilize a washwater booster pump to provide water to clean the belts of the belt filter press. The booster pump shall be a vertical in-line centrifugal pump with cast iron suction/discharge chamber, with a 5.0 horsepower motor.

B. The pump shall be capable of delivering 43 gallons per minute water with 93 psi pressure differential. The motor starter for the washwater booster pump will be included into the main control panel.

2.17 DRIVE MOTOR

A. The 5HP belt drive shall be variable speed, shaft mounted on one drive roller shaft. Drive shall transfer to the second drive roller by means of a gear combination. The gears shall be enclosed by a solid, stainless steel enclosure. The drive motor shall be severe duty TEFC of ample power for starting and operating under normal conditions without exceeding the nameplate horsepower and shall have a service factor of 1.15.

B. The drive shall be Variable Frequency Drive using AC motor and quadruple gear speed reducer. Speed control of the drive shall be in the belt press control panel. The inverter, start/stop and speed control of the drive shall be in the belt press control panel.

2.18 FACTORY WIRING

A. All equipment and components shall be factory wired using non-metallic, flexible liquid-tight conduit and fittings wired to numbered terminal blocks in a frame mounted NEMA 4X junction box. All conduit shall be run and secured inside the MC channel frame wherever possible.

2.19 SAFETY FEATURES

A. Each belt filter press shall be equipped with a lanyard type safety switch with cable encircling three sides of the press at an easily accessible height.

B. Each belt tensioning system shall have a limit switch that shall shut down the system in the event of total belt failure.

C. The belt tracking system shall have a limit switch on each side of the press that shall shut down the system in the event of belt tracking failure.

D. Each pneumatic control center shall have a pressure switch that shall shut down the system in the event of low air pressure.

E. Each gear drive shall have a solid stainless steel enclosure.

2.20 ELECTRICAL CONTROL PANEL

System Controls:

A. General Requirements: Each belt filter press shall be provided with a control panel that will contain the necessary control devices and equipment for controlling the dewatering process as described herein. The control panel shall meet the following general requirements:

    a. The control panel shall accept a 460 volts, 60 hertz, 3-phase ac power input. A main disconnect circuit breaker and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system.

    b. IEC rated motor starters shall be provided for the air compressor, belt wash water booster pump, cross conveyor, and the discharge conveyor.

    c. Variable frequency drive (VFD) shall be provided for the belt drive and sludge feed pump.

    d. Short circuit protection for each motor shall be accomplished utilizing fuses. Individual thermal overload protection shall be provided (except for the belt drive and sludge feed pump).

    e. A control power transformer shall be included that will provide 120 volts, ac control power to the system.

    f. An industrial programmable logic controller (PLC) located in the control panel shall perform all logic functions for the system.

    g. A CONTROL POWER ON/OFF switch shall be located on the front of the control panel. When in the ON position, the CONTROL POWER ON pilot light will be illuminated and control power shall be distributed to the control system. When in the OFF position, the control system shall be held de energized.

    h. An EMERGENCY STOP pushbutton shall be located on the control panel. It shall be a mushroom head style pushbutton that when depressed shall immediately de energize all moving equipment in the system.

    i. An alarm horn shall be included with the control panel for audible alarm annunciation along with a horn silencing button in the front of the panel.

B. Control and Pilot Devices: As a minimum, the following control and pilot devices shall be located on the front of the control panel with nameplates as worded below in UPPERCASE LETTERS:

a. Pushbuttons:

(1) AUTO START
(2) AUTO STOP
(3) SYSTEM RESET
(4) ALARM SILENCE
(5) AIR COMPRESSOR START
(6) AIR COMPRESSOR STOP
(7) WASHWATER PUMP START
(8) WASHWATER PUMP STOP
(9) BELT DRIVE START
(10) BELT DRIVE STOP
(11) SLUDGE PUMP START
(12) SLUDGE PUMP STOP
(13) POLYMER SYSTEM START
(14) POLYMER SYSTEM STOP
(15) CROSS CONVEYOR START
(16) CROSS CONVEYOR STOP
(17) DISCHARGE CONVEYOR START
(18) DISCHARGE CONVEYOR STOP

b. Selector Switches

(1) PRESS HAND/OFF/AUTO MODE
(2) CONTROL POWER ON/OFF

c. Indicator Lights

(1) PREWET CYCLE ON
(2) POSTWASH CYCLE ON
(3) AIR COMPRESSOR RUNNING
(4) WASHWATER PUMP RUNNING
(5) BELT DRIVE RUNNING
(6) SLUDGE PUMP RUNNING
(7) POLYMER SYSTEM RUNNING
(8) CROSS CONVEYOR RUNNING
(9) DISCHARGE CONVEYOR RUNNING
(10) LOW AIR PRESSURE
(11) BELT OVERTRAVEL
(12) BELT BROKEN
(13) LOW POLYMER

d. Speed Potentiometers:

(1) SLUDGE PUMP SPEED
(2) BELT DRIVE SPEED

C. Signal Input and Output Devices:

a. Discrete Input Signals: The control panel shall receive the following discrete input signals from normally open dry contacts in external devices (contacts close when the equipment runs or a fault occurs):

(1) POLYMER SYSTEM RUNNING
(2) POLYMER SYSTEM FAIL

b. Discrete Output Signals: The control panel shall provide the following discrete signals for transmission using normally open, dry contacts (contacts close when the equipment is called to run or a fault occurs):

(1) PRESS RUNNING
(2) PRESS FAULT

D. Sequence of Operation:

a. Automatic Mode of Operation:

(1) The press may be operated in the automatic mode by placing the HAND/OFF/AUTO selector switch in the AUTO position. The operator will next press the AIR COMPRESSOR START pushbutton and allow the pressure to reach normal operating level.

(2) After the air pressure has reached the operating level, the operator will press the AUTO START pushbutton, this will energize the washwater pump and belt drive, illuminate the PREWET CYCLE ON pilot light and start the pre wet time delay. After the pre wet timer times out, the sludge pump, polymer system, cross conveyor and the discharge conveyor will be energized.

(3) Pressing the AUTO STOP pushbutton will de-energize the sludge pump and polymer system, illuminate the WASHDOWN CYCLE ON pilot light and start a washdown time delay. After the washdown timer has timed out, the belt drive, washwater pump, cross conveyor and discharge conveyor will be de energized.

b. Manual Mode of Operation

(1) To operate the press in the manual mode, the operator will place the HAND/OFF/AUTO selector switch in the HAND position. The operator will next start the air compressor by pressing the AIR COMPRESSOR START pushbutton. After the air pressure has reached operating level, start the washwater pump by pressing the WASHWATER PUMP START pushbutton.

(2) The operator will not proceed until the belts are allowed to be fully tensioned. No interlock shall be provided to prevent the operator from starting the belt drive in the manual mode. Pressing the BELT DRIVE START pushbutton will energize the belt drive. At this time, the operator will start the cross conveyor by pressing the CROSS CONVEYOR START pushbutton, the discharge conveyor by pressing the DISCHARGE CONVEYOR START pushbutton, the sludge pump by pressing the SLUDGE PUMP START pushbutton and the polymer pump by pressing the POLYMER SYSTEM START pushbutton.

(3) The system will be stopped by pressing the respective STOP pushbutton in the reverse order stated above.

E. Faults:

a. When any of the following fault conditions occur, in automatic or manual mode, the appropriate fault indicator will be illuminated, the alarm horn will sound and the belt filter press and associated equipment will be de energized:

(1) LOW AIR PRESSURE (amber light)
(2) BELT OVERTRAVEL (amber light)
(3) BELT BROKEN (amber light)
(4) LOW POLYMER (amber light)
(5) BOOSTER PUMP FAULT (flashing run light)
(6) BELT DRIVE FAULT (flashing run light)
(7) SLUDGE PUMP FAULT (flashing run light)
(8) CROSS CONVEYOR FAULT (flashing run light)
(9) DISCHARGE CONVEYOR FAULT (flashing run light)

F. Components:

a. Enclosures: Control panel enclosures shall be free-standing, fabricated of type 304 stainless steel and shall be suitable for NEMA 4X service. Enclosures shall be manufactured by Saginaw Manufacturing.

b. Wiring: All power and control wiring shall be 600 volt, type SIS insulation stranded copper and shall be sized for the required load, 14 AWG minimum.

c. Circuit Breakers: Circuit breakers for the main disconnect shall be thermal magnetic molded case units. Circuit breakers shall be Square D, Class 650, Type FAL.

d. Motor Starters: Motor starters shall be full voltage, nonreversing, IEC style across the line units. Coils shall be 120 volts ac. Siemens type Sirius 3RT10.

e. Selector Switches: All selector switches shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Selector switches shall be Idec Series TWTD.

f. Pushbuttons: All pushbuttons shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10-ampere continuous service. Pushbuttons shall be Idec Series TWTD.

g. Pilot Lights: Pilot lights shall be heavy duty, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC full voltage incandescent type. Pilot lights shall be Idec Series TWTD.

h. Terminal Blocks: Terminal blocks shall be high density, solderless box lug style, with 600-volt rating. Terminal blocks shall be Allen Bradley type 1492.

i. Control Relays: Control relays shall be general purpose type with a 10 amp contact rating, miniature square base and internal on status pilot light. Relays shall be Allen Bradley Type 700-HF Series.

j. Programmable Logic Controller (PLC): The PLC shall be a modular type with discrete and analog capabilities. The CPU shall have 6K minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. The PLC shall be an Allen Bradley Micrologix Type.

k. Variable Frequency Drive (VFD): The VFD shall be UL listed and shall be manufactured by Omron.

2.21 UTILITY REQUIREMENTS

A. Electrical:

B. Power
   a. Belt Drive: 5.0 HP

b. Air Compressor: 1.5 HP
c. Wash Water: 7.5 HP
d. Booster Pump: 5.0 HP

C. Belt Wash Water (water @ 85psi minimum): 55 GPM

D. Pneumatics: 3 cfm at min. 80psi, max. 250psi

2.22 ADDITIONAL ITEMS

A. Press Skid System:

a. The belt filter press shall be mounted on a carbon steel hot dip galvanized skid with one central 8" filtrate drain hole. Location of the drain hole will be determined during submittal phase.

B. Polymer System and Feed Pump Skid System:

a. The L-2 Polymer system shall be mounted on the same carbon steel hot dip galvanized skid as the belt filter press along with the PD sludge feed pump.

C. Polymer System: Model L-2.20, Charter Machine Company or approved equal

System Design:

a. Water Control
   i. Make-up water flow shall be variable and measurable by means of a control valve and sight glass rotometer.
   ii. Make up water slow capacity shall be 2-20 GPM provided at 30psi minimum.
   iii. The inlet stream shall have an electric flow sensor with immersed in-line element capable of transmitting a signal for a low/no-flow alarm. Element shall be removable without plumbing disassembly.
   iv. Unit shall have an electric solenoid valve for on/off control of water flow dilution.
   v. The pressure of the incoming water stream and the outgoing polymer solution stream shall be monitored by a 2" stainless steel liquid filled gauge.

b. Polymer Make-up:
   i. Pump information: Netzsch, 0.2-4.0 GPH or approved equal

ii. A neat polymer metering pump shall be integrated in the system. The pump shall be a positive displacement progressive cavity type.
iii. A 0.5HP, TEFC 230/460 VAC motor shall drive the pump. The motor shall be controlled by a VFD mounted on the unit.
iv. A calibration column read in GPM and milliliters shall be supplied.
v. A sensor shall be placed in the neat polymer feed line to sense a "no-flow" condition.
vi. A check valve shall be placed in the neat polymer feed line to isolate neat polymer from the dilution water.

c. Multi-Zone Mixing Chamber (High Energy)
   i. Polymer shall be injected in the water stream by the feed pump to a kinetic mixing chamber to create a thorough mixing energy. The design shall include a motor driven impeller to create a high impact energy and low fluid shear. Solution shall undergo a tapered mixing intensity slope as it passes through a second recovery zone. Polymer activation efficiency shall be consistent over the entire dilution water range.
   ii. A portion of the mixed polymer is then re-circulated through the mixing chamber ensuring optimum mixing has occurred.
   iii. A transparent section after the mixing chamber shall be provided to observe the solution consistency.

d. Multi-Zone Acrylic Polymer Blending Chamber (Low Energy)
   i. The mixed polymer solution is then transferred to an exclusive acrylic blending chamber allowing the pre-mixed polymer solution to be gently mixed and provide additional retention time to achieve the highest performance.

e. Post-Dilution System
   i. Dilution water shall be split into two streams. Primary water flow shall supply the mixing chamber. Secondary water flow shall be used to post dilute the activated polymer stream. These two streams shall be completely blended by a static mixer prior to exiting the unit.

      1. The post dilution water flow shall be variable and measurable by means of a control valve and a 2-20 GPM sight glass rotometer.
      2. Unit shall have an electric solenoid valve for on/off control of post dilution water flow.

f. Assembly and Frame Work
   i. All components and parts shall be of corrosion resistant construction.

ii. All sheet metal work and frame assemblies shall be of type 304 stainless steel

g. Controls
   i. A local-off-remote switch for the mixing chamber shall be provided.
   ii. A hand-off-auto switch for the polymer injection pump shall be provided.
   iii. The system shall be provided with positive flow logic to signal an alarm in the event of low dilution water flow. This alarm will disable the polymer injection pump from operating when the injection pump is run in the automatic mode.
   iv. The polymer preparation system shall be capable of remote start/stop operation.
   v. Speed control for the neat polymer make-up pump speed rate shall be provided.
   vi. All controls are to be mounted in a NEMA 4X FRP enclosure and wired directly to its components. A common power feed cord with a standard male plug for a 120V, 20-amp receptacle shall be furnished. ***(Receptable by others)***

D. Normal Set of Spare Parts:

   a. Listed as one (1) complete set of dewatering belts, one (1) complete set of doctor blades and one (1) complete set of containment seals.

E. Shafted Screw Conveyor:

   a. Supply one (1) shafted hot dip galvanized carbon steel shafted 10" internal diameter cake inclined screw conveyor with support structures per the drawings.

F. Sludge Positive Displacement Feed Pump:

   a. The manufacturer shall supply one (1) positive displacement style feed pump capable of feeding the 1.7m Tower Press from 25-200 GPM utilizing a maximum of 20HP VFD motor. All controls shall be located in the Belt Filter Press Control Panel.

G. Shafted Screw Conveyor:

   a. Manufacturer shall supply one 30' long shafted screw conveyor with supply bracing and brackets.

Scope:

a. A sludge discharge conveyor shall be supplied as shown on the Contract Drawings. The conveyor shall receive dewatered sludge cake from the belt filter press and convey the material to the sludge storage area.

b. The belt conveyor system shall include; conveyor frame, idler roll belt supports, belt, drive, head pulley with shaft and bearings, tail pulley with shaft and bearings, take-ups, drip pan, skirting, scraper device, belt return flat idler rolls, and safety lanyard.

c. The conveyor shall be a troughing idler roll type, approximately thirty (30') 'feet long by 29 3/4" overall width with a minimum belt width of 18 inches.

d. The conveyor frame and supports shall be constructed of carbon steel channel, sufficiently cross-braced so as to form a rigid structure. Conveyor support base pads shall be drilled for anchor bolt installation by the contractor. All frame members and supports shall be prepared and coated according to ASTM A123, hot dip galvanized to a minimum 5 mil thickness. All frame members shall be drilled and machined, and all bolted connections shall be disassembled prior to galvanizing.

e. The "troughing" section of the conveyor shall be constructed utilizing idler rolls supported at approximate 4' foot centers along the entire troughing length of the conveyor belt. Flat return idler rolls shall be supplied and spaced at a maximum of 10 feet.

f. The conveyor belt shall be a "free slide" belt constructed of a durable PVC top cover and a bare polyester bottom specifically designed for slider bed applications. The belt thickness shall be 3/16" thick with a tension rating of 150 pounds per inch of belt width. The ends of the belt shall be joined together by #25, stainless steel alligator lacing.

g. The head pulley shall be constructed of 10 3/4" diameter face crowned carbon steel with 3/8" thick rubber lagging, machine crowned with a diamond grooved pattern. The tail pulley shall be constructed in the same manner, but without lagging. Both pulleys shall be fastened to their shafts with keyed, tapered bushings. The head pulley shall be mounted to the conveyor frame in fixed pillow block bearings. The tail pulley shaft shall be mounted in 12" long adjustable screw type ball bearing take-ups attached to the conveyor frame.

h. A 1.5 HP, 3 phase, 60 cycle, TEFC induction motor and speed reducer shall be supplied to drive the conveyor belt at a constant speed of 60 feet per minute. The conveyor drive shall be directly mounted to the head pulley shaft.

i. A counterweighted belt scraper, with replaceable blade, shall be installed just after the head pulley to remove material from the conveyor belt.

j. The conveyor shall be supplied with a minimum 14 gauge type 304 stainless steel skirting with rubber seal in the sludge loading area.

k. A minimum 14 gauge type 304 stainless steel drip pan shall be supplied beneath the conveyor frame to collect and convey all material to a common discharge point.

l. An emergency stop switch with safety lanyard cable shall be provided on both sides of the conveyor. All controls, interlocks, and motor starters for the conveyor shall be contained in the belt press control panel.

m. The conveyor will be completely assembled and run prior to shipment.

PART 3 – EXECUTION

3.01 FACTORY QUALITY CONTROL TESTING

A. Factory Quality Control Test: Prior to shipment, the belt filter press and control panel shall be factory tested at the place of assembly. Factory test each pre-assembled, pre-wired, lubricated, and aligned BFP and its associated control panel to be supplied to the job site. Prior to shipment, verify through a one-hour continuous operating test that the BFP and associated equipment operate smoothly, noiselessly, vibration free, and without overheating of any bearing or motor. Particular attention must be given to assure that the BFP is properly aligned for maintaining the centerline-to-centerline tracking of the belts relative to the machine. Submit a certified test report to the Engineer for approval, prior to shipping that demonstrates compliance with all applicable industry standards, manufacturing quality control, and the functional intent of these Specifications.

B. The owner/engineer shall, at their option, be permitted to witness the factory quality control test at the manufacturer's facility. The manufacturer shall give the owner/engineer a minimum of two- (2) weeks notice prior to testing.

C. Alternate manufacturers shall, at no cost to the Owner, conduct a field performance test, at the plant site, within 30 days of the bid opening to demonstrate compliance with

the specified performance criteria. This test must be conducted with a belt filter press of the same design and configuration as the unit proposed for this project, with a minimum effective belt width of 1.2 meter. Test procedures shall assure meaningful results and shall be subject to the approval of the Owner. The Owner, on the basis of qualitative results of this testing, will select the equipment to be supplied.

D. Testing will be conducted as follows:

   a. The objective of the test will be to measure throughput, dewatered sludge solids concentration, polymer usage, and filtrate solids.

   b. Suitable means, acceptable to the Engineer, shall be provided to measure sludge feed rate, filtrate flow rate, washwater feed rate, and polymer feed rate.

   c. Testing shall be conducted for at least one 6-hour period. During the test period, the following data shall be collected at 30 minute intervals by the Construction Manager:

      i. Measure belt speed
      ii. Record polymer type, concentration, and feed rate
      iii. Collect polymer sample
      iv. Record sludge feed rate
      v. Record filtrate feed rate
      vi. Record washwater feed rate
      vii. Collect 200mL filtrate sample for lab analysis
      viii. Collect 200mL dewater sludge sample for lab analysis

3.02 FIELD SERVICE

A. The Manufacturer shall include the services of a factory trained field engineer for the purposes of installation inspection, equipment start-up, polymer selection, performance testing, and training of plant personnel regarding proper operation and maintenance of the equipment.

3.03 START-UP AND OPERATOR TRAINING

A. Services of the manufacturer's factory trained representative, who is specifically knowledgeable in the type of equipment specified herein, shall be provided during the equipment installation period. Upon complete installation of equipment by installing contractor, including placement of equipment, setting and leveling the equipment, piping and electrical connections to all the equipment specified herein, the

manufacturer's service representative will approve the installation and begin start up and training.

B. Upon approval of the installation, the services of the manufacturer's factory trained representative shall be provided at the project site for equipment start-up and calibration. During the start-up and calibration phase the manufacturer's representative shall inspect all system components for proper connection and alignment and assist the installation contractor in placing the equipment in a proper operating condition.

C. Upon satisfactory completion of the start-up and calibration, a representative of the manufacturer shall be provided to instruct Owner's personnel in the proper operation and maintenance of the equipment. The manufacturer's representative who will be providing the instruction shall have prior operation, maintenance and instructing experience acceptable to the Engineer.

D. The manufacturer's representative shall complete all of the above sessions in **one trip** to the jobsite. The equipment manufacturer will request in writing that all installation prior to arriving at the jobsite be completed by the contractor. If the equipment manufacturer arrives at the jobsite and equipment installation is not complete, the equipment manufacturer shall bill the contractor for the installation time, which is not covered under this contract.

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1 per press
Initial operation, Performance Test and Maintenance Instruction	3
Follow-up Instruction and Optimization	2

E. Additional services, other than those provided for by warranties or as specified herein, may be charged to the Owner/Contractor at the manufacturer's standard service rates or as agreed to at the time of the service request.

END OF SECTION

SECTION 15302
SHAFTLESS SCREW LOADOUT CONVEYOR

PART 1 – GENERAL

1.01 SCOPE

A. Description of Work

i. Provide all labor, material and equipment necessary to furnish and install one (1) shaftless screw conveyor as shown on the drawings, and as specified herein.

ii. The conveyor shall consist essentially of flighting, trough, trough ends, bearings, seals, drive, inlet and discharge ports, pivot assembly and supporting steel together with any other items required for a complete conveying system.

B. Related Work

i. All appurtenances including electrical controls, wiring of motor or controls and field painting are as specified under other sections of these specifications.

1.02 QUALIFICATIONS

A. It is the intention of the Specifications to cover minimum acceptable quality of equipment for a complete installation.

B. The conveyor shall be designed in accordance with these specifications.

1.03 EQUIPMENT MANUFACTURER'S SERVICE REPRESENTATIVE

A. Provide for equipment start-up assistance for the equipment supplied. Provide for one (1) eight (8) hour working day to instruct Plant Operators for the equipment supplied. The training period will be integrated by the owner with overall training.

1.04 GUARANTEE AND WARRENTY

A. The equipment shall be unconditionally guaranteed to meet or exceed the design criteria detailed in PART 2 of this Specification section.

PART 2 – PRODUCT

2.01 DESIGN CRITERIA

A. General: The screw conveyor system shall be designed around the dewatering system as shown on the plans.

B. The screw conveyor shall be a 9-inch diameter shaftless design. The conveyor shall be designed to handle dewatered sludge, weighing 60-65 PCF, at a rate of up to 100 cubic feet per hour.

C. The conveyor shall operate at a speed of 25 RPM and be capable of conveying the product from the belt filter press to the loadout container in a clean efficient manner. The conveyor shall pivot about its load point and allow manual positioning for discharge distribution to the loadout container over a radial arc.

2.02 DESCRIPTION OF EQUIPMENT

A. Shaftless Flighting

i. The screw conveyor is to incorporate a 9-inch minimum diameter, full-pitch shaftless flighting formed from 3/4" thick x 2 1/2” wide alloy steel minimum 220 BHN. The flighting shall be capable of conveying the product capacity and all horsepower and torque loadings without exceeding .1 in/ft deflection. The flighting sections shall require field welding, by the installation contractor, with full penetration welds as recommended by the conveyor manufacturer. The flighting shall include a bolted connection to the drive shaft.

B. Drive

i. The conveyor shall be driven by a 230/460 volt, 3 ph, 3 HP minimum, 1800 RPM, TEFC, severe duty motor with 1.15 SF and class F insulation.

ii. Drive motors shall be direct connected to an adapter mounted, AGMA Class II, helical gear motor provided at the conveyor trough end.

iii. The drive package is to provide 25 RPM final screw speed or as required to meet capacity.

C. Trough

i. The conveyor flight shall be housed in a #10 ga. thick minimum type 304 stainless steel trough. The feed-end of the conveyor shall be a split tube trough that transitions to a U-trough with formed top flanges and integral end flanges.

ii. The troughs shall include a 3/8” minimum thickness, 48-inch maximum length, replaceable UHMWP liners from roll line to roll line in the trough interior. Liner retainers shall not penetrate the conveyor trough.

iii. Trough ends shall be 1/4" minimum thickness type 304 stainless steel and will include top flange and support foot.

iv. Discharge ports shall be provided at the location shown for discharge to the loadout container.

v. The cantilevered end of the conveyor shall include stainless steel trough stiffeners to reinforce the trough span and radial travel movement.

vi. The lowest point of the conveyor trough at the tail end shall include a 2-inch minimum diameter drain connection with cap installed.

D. Covers

i. The screw conveyor trough shall include a 14 ga. minimum cover with gasketing. Covers shall be held in place with stainless steel screw clamps or bolts on 24" maximum centers.

ii. An inlet hopper shall be provided to accept loading from the belt filter press and transition to allow clean feed to the conveyor thru its full radial travel.

E. Supports

i. The screw conveyor shall be supported at locations shown on the drawings, spaced no more than 10'-0" on center. The supports shall be fabricated from formed stainless steel formed shapes and plates.

ii. The tail-end conveyor support shall include a pivot bearing to support the vertical loading and prevent uplift. The tail end support shall allow full radial travel and shall also hinge to allow vertical movement for minor variations in the floor elevation thru the full radial travel.

iii. The fore-end support for the conveyor shall be an A-frame design mounted on casters. Casters shall have minimum capacity of 700 pounds each and shall be polyurethane faced and include a manual brake.

F. Flexible Chute Extensions

i. The discharge of the conveyor shall be furnished with a flexible chute extension fabricated from rubber impregnated 18 oz./yd. minimum canvas.

G. Safety Stop Switch

i. The conveyor is to be provided with a NEMA-4, 115 V., safety pull cord stop switch. A continuous orange vinyl coated galvanized cable shall fully surround the conveyor. The cable shall be supported from the conveyor frame on 10 foot maximum centers.

H. Zero Stop Switch

i. The conveyor is to be provided with a non-contacting probe type zero speed indication switch. The probe shall be supplied with stainless steel mounting hardware. The switch shall have a built-in start-up time delay and zero-speed trip time delay.

2.03 CONSTRUCTION

A. The screw conveyor spiral shall be alloy steel. The conveyor trough, covers, inlet, trough ends and supports shall be type 304 stainless steel construction.

B. All welding to be in accordance with the latest AWS standards.

C. All component items shall be provided with manufacturer's standard finish. Shafting and other exposed machined surfaces shall be coated with a rust inhibitive compound.

D. All exposed, accessible rotating parts as well as the drive mechanism to be covered with as OSHA type guard to prevent accidental injury.

E. All nuts, bolts and washers used for assembly to be stainless steel and installed using an anti-seize compound.

2.04 WORK COORDINATION

A. Layout and design of the screw conveyor shall be coordinated with layout of the belt filter press.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's recommendations to provide a complete installation.

END OF SECTION

SECTION 15520
GRIT SEPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include furnishing, unloading at the jobsite, handling, storage and installing of a complete grit separation system. This system shall include two (2) spiral sand separation units, two (2) grit airlift units, and all ancillary equipment, as needed to meet the specified performance requirements.

B. Equipment furnished and installed 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.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted by the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all of the details of construction pertaining to the grit separation system. This shall include installation details of all equipment associated with this system.

3. Detailed electrical schematic and layout drawings and a description/narrative explaining the operation of all control panels.

4. All interconnections and interface requirements, dimensions, and locations of all major elements of the grit separation system including critical clearance requirements.

5. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design and that it will conform to the requirements of this specification.

6. The startup testing report and manufacturer's certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
5. IEEE, Institute of Electrical and Electronics Engineers.
6. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. It is the responsibility of the contractor to ensure that the grit separation system supplier will provide a representative for startup services upon completion of the systems installation. The manufacturer shall provide the following activities.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's personnel on the operation and maintenance of the grit separation system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall provide at a minimum, services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1 per system
Initial Operation, Performance Test and Maintenance Instruction	1
Follow-up Instruction and Optimization	1

4. The number of days indicated above shall be provided on an 8-hour-day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF THE SYSTEM

A. The grit separation system shall consist of two (2) spiral separation units, two (2) grit airlift units and all accessories.

B. The minimum clearance requirements specified herein shall not relieve the contractor from allowing additional clearances for the proper installation, operation, and maintenance of the units. Should equipment other than that specified be proposed, the contractor shall be responsible for any redesign based on the requirements contained herein.

C. The grit removal device shall have less than ¼" head loss. The device shall be capable of removing grit from wastewater and depositing the grit in a storage chamber. The grit removal and storage device shall have no moving parts. Rotating turbines, blades, or submerged bearings will not be approved. Baffling, if required, shall be constructed of fiberglass and installed according to the manufacturer's drawings.

1.06 SPARE PARTS

A. No spare parts shall be required for this system.

1.07 QUALITY ASSURANCE

A. General

1. Only manufacturers of sand separation units and grit airlift units of the type specified herein operating for a period of five years in a minimum of five wastewater treatment plants in the Southeastern United States shall be considered. Manufacturers not meeting the experience requirement shall not be acceptable.

2. All components of the grit separation system shall be of high quality and sized to accommodate, without failure or compromise, all forces encountered during fabrication, installation and operation. Compliance with the performance requirements of the specification shall not relieve the contractor of his responsibility to supply equipment having the specific structural, mechanical, operational and surface corrosion protection features as specified herein.

3. The sand separation unit and grit airlift unit shall be factory assembled and tested prior to shipment to ensure proper operation of all systems.

1.08 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup. In the event that any equipment failure occurs during this time period, it is the responsibility of the manufacturer to repair and/or replace the equipment at no cost to the owner

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The grit separation system must be designed to fit within the specified dimensions shown on the attached drawings and be of modular design.

2. The system to be furnished shall include the latest components and equipment available at the time of shipment.

3. All components exposed to or in contact with plant effluent, including all anchoring hardware, shall be comprised of corrosion/degradation resistant materials. Approved materials shall be as described in this section.

4. The grit separation system shall be able to continuously provide grit and water separation services under varying flow conditions for extended periods of service.

5. The individual unit of the grit separation and removal system shall have a hydraulic capacity of 1.53 MGD design and a peak flow of 6.12 MGD.

6. The system shall be capable of removing 95% of the grit greater than 50 mesh in size, 85% of the grit greater than 70 mesh in size, and 65% of the grit greater than 100 mesh in size.

B. Approved Materials

1. All materials used in the construction of the grit separation system shall be of the best quality and approved in every respect for the service intended by the engineer. All structural steel shall conform to the ASTM Standard Specification for Structural Steel, Designation A36/A36M. All iron castings shall conform to the ASTM Standard Specifications for Gray Iron Castings, Designation A48, and shall be of a class suitable for the purpose intended by the engineer. Other materials shall conform to the ASTM Specifications where such specifications exist and the use of such materials shall be based on continuous and successful use under similar conditions of service.

2. All electrical components shall be U.L. listed where such listings exist, and all electrical control panels shall be assembled in U.L. approved facilities.

2.02 SPIRAL SAND SEPARATION UNIT

A. Spiral Assembly

1. The spiral assembly will consist of a shaftless spiral bolted to a drive shaft attachment.

2. The spiral will be constructed of high-strength carbon steel bar stock, having a minimum thickness of 0.79 inches. The spiral will be prime coated for protection during shipment. The spiral will have a 9.0 inch minimum OD and a minimum flight height of 2.3 inches. The drive end of the spiral will be provided with a welded coupling plate.

3. The drive shaft will be welded to a coupling plate that bolts to the mating coupling plate on the spiral. The shaft will be a solid carbon steel shaft keyed for direct insertion into the hollow shaft of the gear reducer.

B. Trough Assembly

1. The trough assembly shall consist of the trough, trough liner, discharge section, drive system mounting flange, cleanout coupling and trough cover.

2. The U-shaped trough shall be fabricated, at a minimum, of 11 gauge type 304L stainless steel with a 10.24 inch ID. The trough will be mounted at a minimum 25 degree angle.

3. The trough liner shall be fabricated, at a minimum, of a 3/8 inch thick wear resistant rubber liner adhered to a 16 gauge type 316L stainless steel liner that shall be tack

welded to the inside of the trough. Four (4) wear bars shall be longitudinally mounted and tack welded to the inside of the trough liner. Each wear bar shall be, at a minimum, made of 5/16 inch by 1 ¼ inch carbon steel bar stock. One (1) wear bar shall be supplied with a type 18-8 stainless steel cap screw (removable from the outside of the trough), that shall be used as an indicator of the wear rate on the bars.

4. A bottom discharge section will be fabricated at the drive end of the trough. The discharge section will be, at a minimum, fabricated of 11 gauge type 304L stainless steel. A flexible neoprene discharge chute/guard will be fastened to the discharge section and shall guide discharged solids into the customer supplied receptacle. This discharge chute/guard shall not have to be removed or tampered with to empty the disposal receptacle.

5. The drive end of the trough will be capped off with a painted carbon steel plate that will serve as a mounting flange for the drive system.

6. The bottom end of the trough will be equipped with a 4 inch NPT drain. This drain shall be fitted with an aluminum valve and 3" male cam and groove coupling so that a hose drain line can be attached.

7. A 14 gauge type 316 stainless steel cover shall cover the trough from the tank to the drive.

C. Drive Assembly

1. The drive assembly will consist of a motor and gear reducer.

2. The motor shall be, at a minimum, a ¾ HP, 1200 RPM, 230/460 volt, 3 Phase, 60 Hz, Class 1 Division 2 explosion proof motor, NEMA Design B motor with Class F insulation, 1.15 S.F. and rated for severe duty.

3. A shaft-mounted helical gear reducer shall be directly coupled to the motor. The cast iron reducer shall have an output speed of 6.6 RPM, produce 7160 inch-pounds of torque and have a 1.8 S.F. The gear reducer shall be fastened to the mounting flange on the trough assembly.

D. Tank Assembly

1. The tank assembly shall be mounted above the trough assembly and consist of a tank with an overflow chamber and tank covers. The tank assembly shall be designed to support the weight of the spiral and trough, as well as the imposed hydrostatic loads. Approved provisions for lifting the tank shall be supplied by the Contractor.

2. The tank shall be fabricated of 11 gauge type 304L stainless steel, with sides sloped toward the trough assembly. The tank shall be welded to the top of the trough assembly.

3. An overflow chamber, fabricated of 14 gauge type 304L stainless steel, will be mounted inside of the tank assembly. An overflow chamber will be provided with a 6.63 inch OD plain-end discharge pipe stub. The discharge pipe will be located on the left-hand side of the unit, as viewed from the solids discharge end.

4. Tank covers shall be mounted on top of the tank assembly. The cover above the overflow chamber shall be hinged for viewing access. All other covers shall be bolted to the tank. The bolt-on cover section adjacent to the hinged cover shall be supplied with a 4.50 inch OD influent pipe stub. The influent pipe shall be a plain-end pipe connection, centered between the access doors and positioned as is shown on the construction drawing. The doors shall not interfere with the designed pipe configuration. All covers shall be fabricated of 11 gauge type 316 stainless steel and be gasketed.

E. Support Legs

1. Four (4) support legs shall be provided on the unit; two (2) attached to the trough assembly (near the discharge end), and two (2) attached to the tank assembly (near the influent end). Each support leg will be fabricated of 11 gauge type 304 or 316 stainless steel. A 5/16 inch thick mounting pad with a 0.63 inch diameter anchor bolt hole will be provided at the bottom of each support leg.

2. The installing contractor will furnish four (4) ½”-13UNC by 5½ inches long type 304 stainless steel expansion anchors.

F. Surface Finish

1. All welds in stainless steel subassemblies shall be electro-chemically cleaned or acid passivated after welding for corrosion resistance and to provide a superior surface finish. This shall be accomplished by electro-chemically removing heat tint and

discoloration with a device designed for that purpose or by full dipping of weldments, or by using an acid passivation paste in the weld and heat effects areas and spray-on acid solutions elsewhere. After passivation, the weldments shall be thoroughly rinsed with clean water and allowed to air dry. No heat tint or carbon steel contamination shall be evident after this process. If there is contamination evident, the contaminated areas shall be cleaned by the above method and rechecked after rinsing and drying. Sandblasting, bead blasting or grit blasting of stainless steel surfaces shall not be allowed in lieu of the above procedures.

2. The spiral and wear bars shall be prime coated for protection during shipment.

3. The motor and reducer shall be provided with the manufacturer's standard finish.

4. The drive system mounting flange and drive shaft shall be finished with 3.0 mils DFT epoxy powder coating.

G. Emergency Stop

1. A unit mounted emergency stop push button shall be provided in a NEMA-4X polycarbonate enclosure. Emergency stop button to be located on support leg of unit near the grit discharge.

2.03 GRIT AIRLIFT UNIT

A. The grit airlift unit, air-liquid separation unit, circulating motive jet, and grit airlift shall be supported from the existing bridge work.

B. Air shall be introduced at the base of the unit so as to lift and recirculate water in the grit chamber for aerating and scouring. An air-liquid separation unit shall be provided at the top of the airlift unit to separate most of the air from the recirculation stream. The elevated water from the unit shall be used to drive the circulating jet motive nozzle. The jet motive nozzle shall be designed to impinge upon the sloped section of the transition section and provide circulation in the grit chamber.

C. The airlift pump shall be furnished to facilitate grit washing and removal. The diameter airlift pump shall be designed to be concentric with the unit. The airlift pump shall be approved for manual or automated operation by control of the compressed air supply to the airlift unit. The air supply line shall terminate above the bridge work. The terminal end of the air supply pipe shall be furnished with a 1½" diameter automatic control valve. Air supply piping from the source of the air supply to the control valves shall be furnished by the contractor.

D. All parts that are submerged or partly submerged shall be produced of a corrosion resistant, structurally sound, fiberglass reinforced resin in accordance with National Bureau of Standards PS-15-69.

E. Regenerative blower with intake filter shall be provided to supply 110 SCFM at 2.5 psig. Unit shall be provided with a 3.0 HP, 460 V, 3 phase TEFC motor.

F. A positive displacement blower with intake filter, silencer and accessories shall be provided to supply 50 SCFM at 47 psig. The unit shall be provided with a 3.0 HP, 460 V, 3 phase TEFC motor.

2.04 CONTROL PANELS

A. One control panel shall be provided for each spiral sand separation unit. The control panel shall be a NEMA-4X stainless steel enclosure capable of wall mounting. It shall contain the following devices for operation of the equipment:

1. Pump interlock contacts
2. Settling timer
3. Discharging timer
4. Repeat discharge cycle timer
5. Hand-off-auto selector switch
6. Run time meter
7. System start button
8. Fault reset button
9. Emergency stop push button
10. Indicating lights
11. Relays
12. 480/120 V control power transformer
13. Main disconnect switch motor starter and motor current monitor

The incoming power service to the control panel will be 480V, 3 Phase, 60 Hertz.

The spiral motor starter shall be provided with a hand-off-auto selector switch. In the “hand” position, the spiral shall rotate continuously.

When the AUTO mode is selected, an automatic cycle will be initiated upon receiving a signal from the customer’s pump operation. AUTO cycle includes:

1. Tank fill (based upon pump signal)
2. Solids settling
3. Solids discharge (continuous or intermittent)

A fault condition (motor thermal overload or motor current overload) will disable the unit and illuminate a Fault light.

B. One control panel shall be provided for each Hydro-Grit Separation Unit. The control panel shall be a NEMA-4X stainless steel enclosure suitable for wall mounting.

The panel shall house starters for regenerative blower and airlift positive displacement blower. The control panel shall include a "Hand-Off-Auto" selector switch and indicating light for the airlift blower. In the "Auto" position, a 24 hour timer settable in ten minute increments shall start the airlift blower, start a second timer and open the air scour solenoid. When the second timer times out, it shall close the air scour solenoid, open the air lift solenoid, and start a third timer. The third timer shall stop the airlift blower, close the airlift solenoid and reset when the contact on the 24 hour timer releases. Provide an auxiliary contact for airlift pump "run status" to interlock with the spiral sand separation unit specified elsewhere in these specifications.

The power service for the control panel will be 480 V, 3 phase, 60 Hertz.

C. SCADA Requirements: Each unit shall be equipped to communicate with proposed system. The proposed system will incorporate Allen-Bradley PLCs. All vendor furnished field control panels shall be capable of interfacing with the Owner's proposed SCADA system using one of the two methods described below:

1. Field Control Panels without a Programmable Logic Controller (PLC)(Not Preferred -2 points): For field control panels which do not incorporate a programmable logic controller, status, alarm and control signals shall be wired to field terminals in the field control panel for hardwired connection a SCADA panel.

   Digital status or alarm signals from Field Control Panels to the SCADA system (such as equipment running, Hand-Off-Auto selector switch in Auto Mode, motor overload, high level alarm, low level alarm, etc.) shall be wired as dry contacts to field terminal strips. These dry contacts shall be rated at 5 amps minimum at 250 VAC.

   Digital control signals from the SCADA system to Field Control Panels (such as Pump Call-to-Run, Valve Open/Close, etc.) shall be wired as dry contacts to field terminal strips in a SCADA system PLC cabinet. Dry contacts in the SCADA panel shall be rated at 10 amps minimum at 250 VAC.

   Analog status signals from Field Control Panels to the SCADA system (for signals such as level, flow, pH, etc.) shall be 4 to mA isolated signals into 600 ohms minimum.

Analog output signals from the SCADA system to Field Control Panels (for signals such as Pump Speed, set points, etc.) shall be 4 to mA isolated signals into 600 ohms minimum.

2. Field Control Panels with a Programmable Logic Controller (PLC)(Preferred): For field control panels which incorporate a programmable logic controller, the PLC must be capable of Ethernet communications using Allen-Bradley's Ethernet/IP protocol. No other communications protocols will be approved. Input/Output (I/O) signals for status, alarm, set points, controls, etc. shall be mapped within the PLC to contiguous data registers to facilitate efficient data transfer to/from the SCADA system.

   The equipment vendor shall furnish to the Owner's System Integrator detailed I/O listings containing each signal name, range or status, PLC address and all other pertinent information as required for interface of the vendor's equipment into the existing SCADA system.

   As a minimum, each Field Control Panel that incorporated a programmable logic controller shall include a 4-port Ethernet switch to facilitate programming connections and connection to the Owner's existing SCADA system via Cat 6 cable.

2.05 FIBERGLASS REINFORCED POLYESTER GRIT PIPING

A. The grit slurry piping shall be cylindrical having an inner diameter of 4-inches and shall be internally smooth and free from protrusions which might collect solid material. The grit slurry pipe shall be fabricated of machine filament wound, fiberglass reinforced thermosetting resin pipe conforming to ANSI/ASTM Specification D-2996 and classified according to ASTM D-2310.

   The piping shall use an isophthalic, corrosion resistant laminating resin; reinforced with glass fibers and a surfacing material of commercial grade chemical resistant glass having a coupling agent. The pipe shall have a 50 psig pressure rating. The piping shall have a minimum structural thickness of 0.375-inch. The piping shall include an abrasion resistant 20-mil internal liner. All piping shall be provided with an UV inhibiting gelcoat. FRP piping shall be provided by Fluidyne Corporation as part of the overall grit removal system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the complete installation of each of the two grit separation systems. Installation shall not be considered to be complete until the equipment has been tested under normal and peak loading conditions for the facility and has been proven to successfully handle such flow rates.

B. It shall be the responsibility of the Contractor to install each component of the system as it is received.

C. It shall be the Contractor's responsibility to ensure a safe installation, free from: flaws in equipment alignment, damage, and damage to any of the existing structures or components. If damage to the grit separation system, any of its equipment, or any of the existing structures does occur, it is the Contractors responsibility to repair these items to their original specifications at no charge to the owner. If the equipment or structure is deemed to be beyond repair by the engineer's representative, it shall be the responsibility of the Contractor to replace the item at no charge to the Owner.

D. It is the responsibility of the Contractor to make all specified pipe connections. These connections shall be seated properly and free of all leaks. Piping for the system shall be installed as specified in the construction drawings and shall include all required pipe lengths and spacing.

E. The Contractor shall be responsible for assembly and installation of all electrical and accessory equipment required by the manufacturer and engineer for successful and efficient equipment operation. Installation of all electrical equipment shall be performed by a licensed qualified electrician and in accordance with the NEC and all federal, state, and local regulations.

3.02 GENERAL TESTING REQUIREMENTS

A. The manufacturer shall furnish the services of a factory-trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements as set forth by the manufacturer and engineer. If the system fails to meet the specified requirements, it shall be adjusted, repaired and/or replaced at no additional cost to the Owner.

3.03 FUNCTIONAL TESTING

A. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer two (2) weeks prior to installation of the grit removal system. If the proposed testing requirements are found to be insufficient by the engineer, the engineer will submit the changes that must be made in the testing program back to the manufacturer. The manufacturer will then have two (2) working days to resubmit the testing program to the engineer for approval.

B. Prior to startup, a manufacturer's and engineer's representative shall inspect the system for proper alignment, correct operation, proper connection, and satisfactory function of all components. When final approval of the system is given, the manufacturer's and engineer's representative shall provide certification that the system components have been installed correctly and are ready for operation. Until such time as written approval is given by both the manufacturer's and engineer's representative, it is the Contractors responsibility to make the required repairs, changes, and adjustments to the ensure delivery of a system free from defects of any kind.

END OF SECTION

SECTION 15530
SEWAGE SCREENING
AUTOMATIC SELF-CLEANING FILTER SCREEN EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include furnishing, unloading at the jobsite, handling, storage and installing of one (1) model AWP8-2 Aqua Washpress unit, as supplied by Parkson Corp., Vernon Hills, IL or approved equal. The screen unit will consist of a Main Body, Screw, Wash Sprays, Flush Sprays, Drive System, Covers, Feed Hopper, Discharge Piping and Controls as specified at the Folkston Water Pollution Control Plant. The system shall include one (1) fully automatic self-cleaning filter screen, complete with accessory equipment (e.g. waste compaction system), as required to meet the specified performance requirements.

B. The equipment will be of the latest design and will be fabricated of the specified materials and in a fashion that will fully perform the functions described in these specifications.

C. The filter screen shall be approved for installation and operation in the appropriate flow channel as specified in the attached drawings. The angle-of-inclination for both required filter screens shall be within 75 to 80 degrees from the horizontal, and the channel floor shall have a minimum recess of that specified by the manufacturer. The geometry of the channel shall be verified with the attached drawings, by the contractor prior to installation of the filter screen to ensure continuity between the existing and proposed filter screen installations.

D. Each screen shall fit in the existing opening with minimal channel wall modifications. Both filter screens shall be provided by the same manufacturer and be the same model. This will provide consistency for operations and maintenance. The filter screens shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during continuous operation. Each filter screen shall meet the following criteria:

Parameter	WWTP
Avg. flow rate	1 MGD
Peak flow rate	3 MGD
Channel width	2.5 ft
Channel depth	5.50 ft
Screen angle	75^{o}
Element size	6 mm

Max. downstream water level	2.50 ft
Max. upstream water level	4.50 ft
Max. height above floor	N/A

E. Equipment furnished and installed 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.

F. Only equipment defined as a filter screen and meeting the requirements herein will be accepted. No bar screens, screw auger filtering devices, or the like will be accepted.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted by the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all of the details of construction pertaining to the filter screen system. This shall include installation details of all equipment associated with this system.

3. Detailed schematic and layout drawings and a description/narrative explaining the operation of all control panels.

4. All interconnections and interface requirements, dimensions, and locations of all major elements of the filter screen system including critical clearance requirements.

5. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design.

6. The startup/performance testing report and manufacturer's certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
1. IEEE, Institute of Electrical and Electronics Engineers
2. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. The supplier/manufacturer shall provide a representative for startup services upon completion of the systems installation. The following activities shall be provided by the manufacturer.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the filter screen system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The manufacturer's representative shall provide at a minimum, services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1 per screen
Initial operation, Performance Test and Maintenance Instruction	3
Follow-up Instruction and Optimization	2

5. The number of days indicated above shall be provided on an 8-hour per day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF THE SYSTEM

A. The filter screen system shall consist of one (1) filter screen and all accessories. All filters shall have dual or mixed media and be operated at a rate between 2 and 5 gpm/ft2.

B. Approved filter screen units shall be the Aqua Guard Filter Screen Model AGUC-MN-A 75° as manufactured by Parkson Corporation with Aqua Washpress Screenings Washer/Compactor Model AWP8-3, Raketec screen as manufactured by Aqualitec with compactec washer compactor or approved equal.

C. Designs employing the use of cables, hydraulic cylinders, or rakes to remove debris from the channel will not be approved. As well as, the use of two (2) or more motors to complete a screening cycle will not be approved.

D. The design shall be such to ensure that all planned maintenance to the raking/screening mechanism can be accomplished at the operating floor level.

E. No moving parts shall be located permanently below the channel water surface at maximum design flow.

1.06 SPARE PARTS

A. The following spare parts shall be furnished with each of the filter screens and shall be of factory direct parts:

20 - Filter Elements
10 - Side Plates
10 - Snap Rings, 1 3/8” Dia.
10 - Snap Rings, 1 5/8” Dia.
4 - Rotating Brush Elements or Scraper Blade Elements

1.07 QUALITY ASSURANCE

A. Only manufacturers of fully automatic self-cleaning filter screens of the type specified herein operating for a period of five years in a minimum of five wastewater treatment plants in the Southeastern United States shall be considered. Manufacturers not meeting the experience requirement will not be approved.

B. All components of the filter screen equipment shall be of high quality and sized to accommodate, without failure or compromise, all forces encountered during fabrication, installation and operation. Compliance with the performance requirements of the specification shall not relieve the contractor of his responsibility to supply equipment having the specific structural, mechanical, operational and surface corrosion protection features as specified herein.

C. The filter screen shall be factory assembled and tested prior to shipment to ensure proper operation of all systems.

1.08 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The filter screen system must be designed to fit within the specified dimensions shown on the attached drawings and be of modular design.

2. The system to be furnished shall include the latest components and equipment available at the time of shipment.

3. All components exposed to or in contact with plant effluent, including all anchoring hardware, shall be comprised of corrosion/degradation resistant materials (see Paragraph 2.01B

4. The filter screen system shall be able to continuously provide waste separation services under varying flow.

B. All moving wetted parts, all wetted parts on which the moving parts ride, and all components under guiding, bearing or driving loads including, but shall not be limited to the shafts, links, and guide rails must be fully corrosion-resistant and shall be made of 304 stainless steel for the filter screen, 316 stainless steel for the WWTP filter screen or

wear resistant heat treated 400 series stainless steel for either screen, except as noted in the following:

1. The screening element shall be constructed of a material that will not shred trash or cause jamming due to the self-relieving nature of the material.

2. The roller and bushings shall be of 400 series heat treated stainless steel with a minimum Rockwell of 39C hardness for reduced wear and increase the long life of the equipment.

3. The stationary frame, main drive shaft and sprockets shall be constructed of 316 stainless steel for the WWTP.

4. The take-up screws shall be constructed of 316 stainless steel for the WWTP.

5. The front seal brush and rotating brush, if required, shall have nylon bristles.

6. The side seals shall be made of neoprene rubber with backing plates constructed of 316 stainless steel for the WWTP.

7. All nuts and bolts will be 316 stainless steel for the WWTP.

8. The discharge chute shall be 316 stainless steel for the WWTP.

9. All other appurtenances including chains, brush spockets, bearing housings, etc. shall be of the manufacturer's standard coating material.

10. The WWTP filter screen shall have a 316 stainless steel removable outer covering. This outer covering shall not interfere with the machines separation and shall serve the intended purpose to trap all waste gases inside the machine. This cover shall fit with the proposed channel covering system and create an airtight barrier.

2.02 FILTER SCREEN MECHANICAL DETAILS

A. The screening rollers shall be at a minimum 1 ¾" diameter and shall ride on ½" thick 316 stainless steel at the WWTP. A submerged curved ½" thick stainless steel rail shall be provided at the foot of the screen. No submerged bearings or sprockets shall be allowed in order to eliminate maintenance required on submerged components.

B. To prevent deflection, the filter shafts shall have a minimum thickness of ¾" diameter and spaced on 4" centers in the travel direction of the belt; and shall be made of 316 stainless steel for the WWTP. This is required to ensure structural integrity and smooth operation without jamming or binding.

C. The tension of the moving screen belt assembly shall be completely supported by a stainless steel link chain. The chain must connect the filter shaft ends, on both sides of the belt assembly, so that no weight is supported by the filter elements. The chain assembly shall provide a minimum cross section of 0.114 square inches, at the weakest point of any individual link.

D. The shafted screw will be provided to convey screenings through the various stages of the unit. The screw will be constructed of carbon steel and finished with alkyd enamel paint. The spiral will be 8.00 inches OD and have minimum 0.63 inch thick flights. A replaceable 0.25 inch wide nylon brush with a stainless steel casing will be attached with bolted clips to the spiral OD throughout the inlet area to scour the perforated sheet. The brush OD will be 8.50 inches.

E. No plastic elements shall be used as structural members for load bearing purposes.

2.03 SCREEN BELT CLEANING

A. The filter screen shall be automatically self-cleaning without requiring water or external mechanical devices. The drive mechanism shall be protected from the trash stream and the driving force must be transmitted to clean, trash free components to avoid mistracking or binding which may render the filter screen inoperable and thereby requiring manual cleaning and realignment. In addition, no auxiliary cleaning devices, which may cause trash to be dropped into the interior of the filtration belt will be allowed to prevent jamming of the filtration belt.

2.04 FILTER SCREEN MOUNTINGS

A. The filter screen shall require no mounting or fastening to the sidewalls or bottom of the channel. Routine service shall be possible with the filter screen in the channel.

2.05 DRIVE UNIT

A. The drive unit shall be a hollow shaft, helical worm type reducer equipped with anti-friction bearings, and designed in accordance with AGMA recommendations for 24 hours, Class II service. The unit drive system will consist of a gearmotor mounted on a sealed drive mounting bracket and a drive shaft that connects the gear reducer output to the shaft of the screw. Overload protection shall be provided by an electrical overload device that senses motor current draw.

1. The motor shall have the following characteristics:
   a. Minimum of 0.5 HP, maximum of 5 HP
   b. 3 phase
   c. 230/460 volt
   d. 60 HZ
   e. Class 1 Division 2 Explosion Proof
   f. NEMA Design B
   g. Class F insulation
   h. 40^{o} C ambient temperature rise
   i. rated for severe duty

2. The gear reducer will meet the following criteria:
   a. AGMA class 1 (1.6 service factor, 1.4 minimum)
   b. 94% efficiency
   c. Output speed of 14 rpm
   d. Output torque of 13,900 inch-pounds
   e. Heavy duty roller bearings provide max thrust capacity of 6,740lbs

3. Drive Mounting Bracket: A drive mounting bracket will be provided to mount the gearmotor to the drive end support leg of the unit. The bracket will be made of type 304L stainless steel. A compression type packing gland seal will be provided on the mounting bracket to seal the drive shaft. PTFE packing rings will be fitted into the seal housing, and held in place by a two-bolt stainless steel gland follower.

4. Drive Shaft: The drive shaft will be direct coupled to the spiral and constructed of carbon steel. The shaft will be painted, except in the area of the shaft that extends into the hollow bore of the reducer.

2.06 SCREENINGS COMPACTOR (One (1) compactor for two (2) screens)

A. General

1. Only compaction systems utilizing an auger type screw to transport the screenings through a compression/dewatering tube will be accepted.

2. The press housing shall be made of 316 stainless steel for the WWTP (ASTM 240).

3. The new press screw shall be made of 304 stainless steel (ASTM 240) or high strength carbon steel that has been coated for corrosion resistance. The screw shall be attached to the drive shaft in a manner, which allows for ease of maintenance.

4. The reject water trough and removable splash guard shall be of 316 stainless steel for the WWTP.

5. The spray filter shall be made of 316 stainless steel for the WWTP.

6. The drive shaft shall rotate on two axial/radial tapered roller bearings.

B. Support Structures

1. The support plates shall be integral to the main body of the unit and shall be made of 304 stainless steel (ASTM 240).

C. Solids Discharge Zone

The solids discharge zone shall be of a specified type and be one of the following:

1. A spring-loaded counterforce attached to the outside of the compactor and plate hinged at the outlet of the unit.

2. A stainless steel pipe extension flanged to the outlet to extend dewatering time and enhance frictional dewatering forces.

D. Dimensions of Compactor

1. The compactor shall be specifically manufactured and guaranteed by the Contractor to fit into the existing areas without any modifications to existing structures. The compactor and screen housings shall be connected for the main purpose of trapping all waste gases in an enclosed mechanical system.

E. Performance Capabilities

1. The compactor shall be capable of handling a minimum of 35 ft.^{3}/hr. (or 4m^3/hr.) of wet screenings with a minimum feed concentration of 8-10% dry solids and shall be capable of compressing the screenings to achieve and 75% reduction in volume.

2.07 DISCHARGE PIPING

A. A 14 gauge (.075 inch) stainless steel discharge pipe will be fitted to the discharge end support leg to direct screenings into a customer provided receptacle. All discharge pipe flanges will be 304L/316L stainless steel. Aluminum flanges will not be allowed.

B. Pipe supports, if needed, will be supplied by the supplier.

C. All fasteners will be type 18-8 stainless steel.

D. Weld size, type, and procedure will provide the necessary strength and facilitate the manufacturing of the specific component.

2.08 CONTROLS

A. A NEMA 4X stainless steel control panel shall be provided for operation of the filter screen/compactor combination. If secondary control panel(s) are utilized, they must also be of that specified for the primary.

B. The main control panel wiring shall contain all power and control devices shown on the drawings (wiring diagrams) which shall include, but not be limited to, the following:

1. One (1) Hand/Off/Automatic selector switch for manual operation of the filter screen drive.

2. One (1) Forward/Off/Reverse selector switch for manual operation. Spring return form reverse.

3. One (1) pilot light for “Screen Forward’ run status

4. One (1) pilot light for “Screen Reverse” run status

5. One (1) pilot light for control power

6. One (1) control power “Off/On” selector switch

7. One (1) 24 hour single channel electronic control timer to automatically initiate operation of the filter screen

8. Control relays, wiring and circuitry required to implement the control logic

C. Controls shall operate the screen and compactor on a timed, liquid level control signal or continuous basis.

D. Main Power Control

1. The control panel shall be totally enclosed, front access type with top/side/bottom entry. All controls shall be manufactured by a U.L. listed control panel facility.

2. Construction of the control panel shall be NEMA 4X, 304 stainless steel construction with indicating devices and switches mounted on the front door.

3. The solenoid valves will meet the following criteria:
   a. 120 Volt
   b. Single phase
   c. 60 HZ
   d. 18 inch long integral leads
   e. 1/2 inch NPT conduit connections

4. A NEMA 4X polycarbonate emergency stop push button station will be mounted to the drive end flange and will have a 3/4 inch NPT conduit connection.

5. Main control panel:

   a. wiring shall be neatly cabled and supported in nonflammable wiring raceways.
   b. Programmable relay to monitor equipment mounted electrical devices to perform necessary logic functions.
   c. Emergency Stop push button.
   d. Hand-Off-Auto selector switches for the drive, wash and flush water sprays.
   e. Control power and spiral run incandescent indicating lights.
   f. Current monitor
   g. Fault and fault reset push button incandescent light.
   h. Run and fault auxiliary output contacts for customer use.

E. SCADA Requirements: Each unit shall be equipped to communicate with proposed system. The proposed system will incorporate Allen-Bradley PLCs or approved equal. All vendor furnished field control panels shall be capable of interfacing with the Owner's proposed SCADA system using one of the two methods described below:

1. Field Control Panels without a Programmable Logic Controller (PLC)(Not Preferred -2 points): For field control panels which do not incorporate a programmable logic

controller, status, alarm and control signals shall be wired to field terminals in the field control panel for hardwired connection a SCADA panel.

Digital status or alarm signals from Field Control Panels to the SCADA system (such as equipment running, Hand-Off-Auto selector switch in Auto Mode, motor overload, high level alarm, low level alarm, etc.) shall be wired as dry contacts to field terminal strips. These dry contacts shall be rated at 5 amps minimum at 250 VAC.

Digital control signals from the SCADA system to Field Control Panels (such as Pump Call-to-Run, Valve Open/Close, etc.) shall be wired as dry contacts to field terminal strips in a SCADA system PLC cabinet. Dry contacts in the SCADA panel shall be rated at 10 amps minimum at 250 VAC.

Analog status signals from Field Control Panels to the SCADA system (for signals such as level, flow, pH, etc.) shall be 4 to mA isolated signals into 600 ohms minimum.

Analog output signals from the SCADA system to Field Control Panels (for signals such as Pump Speed, set points, etc.) shall be 4 to mA isolated signals into 600 ohms minimum.

2. Field Control Panels with a Programmable Logic Controller (PLC)(Preferred): For field control panels which incorporate a programmable logic controller, the PLC must be capable of Ethernet communications using Allen-Bradley's Ethernet/IP protocol. No other communications protocols will be approved. Input/Output (I/O) signals for status, alarm, set points, controls, etc. shall be mapped within the PLC to contiguous data registers to facilitate efficient data transfer to/from the SCADA system.

   The equipment vendor shall furnish to the Owner's System Integrator detailed I/O listings containing each signal name, range or status, PLC address and all other pertinent information as required for interface of the vendor's equipment into the existing SCADA system.

   As a minimum, each Field Control Panel that incorporated a programmable logic controller shall include a 4-port Ethernet switch to facilitate programming connections and connection to the Owner's existing SCADA system via Cat 6 cable.

2.08 OVERLOAD PROTECTION

A. Positive overload protection against an object, which is too large to be passed over, shall be provided by the use of a control panel mounted, current sensitive relay (CSR). The CSR shall continuously monitor the motor current to prevent damage to the drive

assembly due to a jam obstruction or system malfunction. Machines that rely solely on rake arm rotation in conjunction with mechanical limit switches or proximity switches to provide over torque protection shall not be allowed. Designs that utilize shear pins are specifically excluded.

PART 3 - EXECUTION

3.01 PROPOSED FILTER SCREEN INSTALLATION

A. The Contractor shall be responsible for the complete installation of the bar screen. Installation shall not be considered to be complete until the equipment has been tested under normal and peak loading conditions for the facility and has been proven to successfully handle such flow rates (as determined by representative of the engineer and manufacturer).

B. The filter screen will be received onsite as one unit and it shall be the responsibility of the Contractor to install the press as it is received.

C. It shall be the Contractor's responsibility to ensure a safe installation, free from flaws in equipment alignment, equipment damage, and damage to any of the existing structures or components. If damage to the filter screen, any of its equipment, or any of the existing structures does occur, it is the Contractors responsibility to repair these items to their original specifications at no charge to the owner. If the equipment or structure is deemed to be beyond repair by the engineer's representative, it shall be the responsibility of the Contractor to replace the item at no charge to the Owner.

D. Each filter screen shall be attached to the channel as shown in the construction drawings and as specified by the manufacturer's and engineer's representative. If the attachment method is by means of bolting, the bolts shall be torqued to that specified by the manufacturer to ensure a securely anchored support for the screen and all of the associated equipment.

E. It is the responsibility of the Contractor to make all required pipe/hose connections as specified. These connections shall be seated properly and free of all leaks.

F. The Contractor shall be responsible for assembly and installation of all electrical and accessory equipment required by the manufacturer and engineer for successful and efficient equipment operation. Installation of all electrical equipment shall be

performed by a licensed qualified electrician and in accordance with the NEC and all federal, state, and local regulations.

3.02 PERFORMANCE REQUIREMENTS

A. The screens unit will be capable of the following performance:

a. The screens unit will be designed to receive and wash screenings, then reduce the volume and water content by means of a pressing action. Screenings to be washed will be gravity fed to the drainage trough and conveyed by the screw towards the washing section. Wash water is added, which back flows the screenings, while the spiral alternately stops and restarts to convey the screenings through the wash section. The wash water is then turned off and the screenings are discharged and dewatered by the backpressure generated in the discharge pipe.

b. The unit will be installed outdoors in a non-hazardous area.

c. The unit's controls will be installed outdoors in an unclassified area.

d. The unit will be suitable for installation and operation in the designated space.

e. The unit will have an inlet capacity of 35 cubic feet per hour, handling wet screenings with an approximate dry weight of not less than 8% solids.

f. Utilities

i. Total Spray wash (max @ 60 psi): 15 gpm
ii. Power Supply 460 / 3/ 60

3.03 GENERAL TESTING REQUIREMENTS

A. The filter screen shall be factory assembled and tested for minimum of 8 hours prior to delivery and shall be delivered to the site as fully assembled as possible. It shall be capable of being set in place and field erected by the contractor with minimal assembly

B. The manufacturer shall furnish the services of a factory-trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements as set forth by the manufacturer and engineer. If the system fails to meet the specified requirements, it shall be adjusted, repaired and/or replaced at no additional cost to the Owner.

3.04 FUNCTIONAL TESTING

A. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer two (2) weeks prior to installation of the filter screen. If the proposed testing requirements are found to be insufficient by the engineer, the engineer will submit the changes that must be made in the testing program back to the manufacturer. The manufacturer will then have two (2) working days to resubmit the testing program to the engineer for approval.

B. Prior to startup, a manufacturer's and engineer's representative shall inspect filter screen system for proper alignment, correct operation, proper connection, and satisfactory function of all components. When final approval of the filter screen system is given, the manufacturer's and engineer's representative shall provide certification that the system components have been installed correctly and are ready for operation. Until such time as written approval is given by both the manufacturer's and engineer's representative, it is the Contractors responsibility to make the required repairs, changes, and adjustments to the ensure delivery of a filter screen system free from defects of any kind.

END OF SECTION

SECTION 15540
SEWAGE SCREENING
MANUAL CLEANING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include furnishing, unloading at the jobsite, handling, storage and installing of one (1) model OR-TEC Manually Cleaned Bar Screen, as supplied by OR-TEC Inc., Cleveland, OH or approved equal. One (1) Manually Cleaned Bar Screen will be used at the headworks of the wastewater treatment plant to remove debris including stringy rag-like materials from the influent sewage. The screen unit will consist of a perforated drying deck, manual rake, bar screen panel, and two side frames. The system shall include accessory equipment as required to meet the specified performance requirements.

B. Manufacture screen complete with related accessories as indicated on the included drawings and specified herein.

C. The filter screen shall be approved for installation and operation in the appropriate flow channel as specified in the attached drawings. The angle-of-inclination for the required filter screen shall be within 45 to 60 degrees from the horizontal, and the channel floor shall have a minimum recess of that specified by the manufacturer. The geometry of the channel shall be verified with the attached drawings, by the contractor prior to installation of the filter screen to ensure continuity between the existing and proposed filter screen installation.

D. The screen shall fit in the existing opening with minimal channel wall modifications. The filter screen shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during continuous operation. The filter screen shall meet the following criteria:

Parameter	WWTP
Total Average Flow	1 MGD
Max Flow Rate	2 MGD
Peak Hourly Flow Rate	3 MGD
Channel width	2.5 ft
Channel depth	5.50 ft
Screen angle	60^{o}
Element size	1/2"

E. Manufacture screen complete with related accessories as indicated on the included drawings and specified herein.

1.02 SUBMITTALS

A. Drawings: Shop drawings shall be submitted for the screen and its associated components. Scaled dimension drawings, layout drawings, anchor and installation details, and details of major components will be included.

B. Product Data: Manufacturer's technical data and installation instructions will be submitted along with pertinent data to substantiate material compliance with project requirements.

C. Operation and Maintenance Manuals: One (1) copy of installation and operational manuals complete with operation and maintenance instructions will be submitted including an arrangement drawing for layout/installation.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
5. IEEE, Institute of Electrical and Electronics Engineers
6. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.04 DESCRIPTION OF THE SYSTEM

A.	Model Number:	OMS
B.	Type:	Manual Cleaned Bar Screen
C.	Screen Opening:	½"
D.	Screen Angle:	60°
E.	Channel Size:	30" wide
F.	Max Depth in Channel:	66" deep
G.	Drying Deck:	Provided at grade
H.	Rake:	Provided
I.	Material :	Main Frame, Bar, Rake : STS 304L

1.05 QUALITY ASSURANCE

A. Acceptable Manufacturer: Or-Tec Inc, Manual Bar Screen or Engineer pre-approved equal.

B. Manufacturer: Shall furnish a fully functioning screen as dictated by the accepted Scope of Supply. Manufacturer shall have produced similar process configurations for a period of at least (5) five years.

C. Manufacturer's Services: Manufacturer's personnel, for the equipment specified herein, shall be present at the job site for a minimum of one (1) day, travel time excluded, for inspection of installation, certification of field testing and adjustment. Additional field service will be provided at a reasonable fee or at no charge, depending on the circumstances of the visit. Manufacturer's representative must have a full equipped service facility with qualified technicians certified to service the equipment.

1.06 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup.

PART 2 - PRODUCTS

2.01 STRUCTURE

A. The Manual Bar screen shall be consist of a bar screen panel, two side frames, perforated drying deck and manual rake.

B. Equipment shall be installed so as not to obstruct the flow of sewage to bar screen. Screen components including shapes (rods, angles, and channels), side frames, bar rack, rake, drying deck, fasteners and anchor bolts shall be manufactured from Type 304 stainless steel. Manual screens with any of these items manufactured from materials other than 304 stainless steel shall not be acceptable.

2.02 BAR SCREEN PANEL

A. Screen panel face shall be made of a parallel array of bars with even spaces between them. Bars shall be 1/4" wide and 1" deep. Bars shall be fully welded in a stainless steel frame.

B. The mid-section of the bar is cross-supported by support beams at every 20" interval.

C. All material for bars, drying deck, rake and the support beams shall be made of 304 Stainless Steel. The bar screen panel shall be mounted and bolted between a pair of side frames. Screens which utilize material other than stainless steel as the main screen media shall not be acceptable for this project.

D. The screen shall be supplied with a rake that allows operators to manually clean the screen face. The rakes penetrating teeth shall fully clean the gaps between the bars and keep the screen operational. Screens shall be drawn up the face of the screen and discharged onto a perforated drying deck at grade.

PART 3 - EXECUTION

3.01 PROPOSED FILTER SCREEN INSTALLATION

A. General: Install screen and associated components as shown on the plans

3.02 TESTING AND INSPECTION

A. General: Notify Owner and Engineer in writing when the installation is complete and ready for testing and start up.

B. Inspect components for proper installation, wiring and piping.

C. Operate all components and check for proper operation. Make necessary adjustments.

PART 4 - CLARIFICATIONS

4.01 Unless specifically mentioned in this proposal for inclusion with the proposed agreement, the aforementioned price DOES NOT INCLUDE:

<u>Spare Parts:</u>

1. Electrical motors, devices, controls, wiring (other than outlined)
2. Piping, valves, fittings, hangers, or supports (other than outlined)
3. Equipment erection or field welding
4. Concrete work, grout, or sealant
5. Lubricating oil or grease

4.02 Seller shall use reasonable efforts to meet specified drawing schedules and shipment dates, but such dates are estimates provided only to serve as a guide to the Contractor, and not guaranteed. No liability, direct or indirect, is assumed by manufacturer for failure to ship on such dates. Contractor agrees to expedite issuance of the written purchase order and approval of drawings.

4.03 Seller retains the title and right of repossession to the equipment until the full purchase price has been paid. Purchaser will not encumber nor permit other to encumber said equipment by any liens or security instruments until the full purchase price has been paid.

4.04 Contractor agrees not to back charge for labor, materials or other such costs unless previously approved in writing by an authorized employee of seller.

END OF SECTION

SECTION 15542
PRESTRESSED CONCRETE STORAGE TANK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies the design and construction of an ANSI/AWWA D110 wire-wound prestressed concrete storage tank with a Type II core wall and galvanized steel diaphragm including all reinforcing, concrete work, accessories, disinfection and testing directly related to the tank.

B. The tank contractor is responsible for furnishing all labor, materials, tools, and equipment necessary to design and construct the prestressed concrete storage tank as indicated on the drawings and as described in this specification.

1.02 REFERENCES

A. ACI 117-10 – Specification for Tolerances for Concrete Construction and Materials

B. ACI 301/301M-10 – Specifications for Structural Concrete for Buildings

C. ACI 305R-10 – Guide to Hot Weather Concreting

D. ACI 306R-10 – Guide to Cold Weather Concreting

E. ACI 347R-04 – Guide to Formwork for Concrete

F. ACI 350/350R-06 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

G. ACI 350.3-06 – Seismic Design of Liquid-Containing Concrete Structures and Commentary

H. ACI 372R-03 – Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures

I. ACI 506R-05 – Guide to Shotcrete

J. ACI 506.2-95 – Specification for Materials, Proportioning, and Application of Shotcrete

K. ACI SP4 – Formwork for Concrete

L. ANSI/AWWA D110-04 – Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

M. ASCE Standard 7-10 – Minimum Design Loads for Buildings and Other Structures

N. ASTM A416/A416M-12a – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

O. ASTM A615/A615M-12 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

P. ASTM A653/653M-11 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by Hot Dip Process

Q. ASTM A821/A821M-10 – Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks

R. ASTM A882/A882M-04(2010) – Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Strand

S. ASTM A884/A884M-12 – Standard Specification for Epoxy Coated Steel Wire and Welded Wire Reinforcement

T. ASTM A1064/A1064M-12 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

U. ASTM C31/C31M-12 – Standard Practice for Making and Curing Concrete Test Specimens in the Field

V. ASTM C33/C33M-13 – Standard Specification for Concrete Aggregates

W. ASTM C39/C39M-12a – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

X. ASTM C143/C143M-12 – Standard Test Method for Slump of Hydraulic-Cement

Y. ASTM C172/C172M-10 – Standard Practice for Sampling Freshly Mixed Concrete

Z. ASTM C231/C231M-10 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

AA. ASTM C881/C881M-10 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

BB. ASTM D1056-07 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber

CC. ASTM D1557-12 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

DD. ASTM F593-13 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

EE. "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard" by P.K. Malhotra, Structural Engineering International, IASBSE, 3/2006 pp 222-225

FF. (Insert other references here as necessary.)

1.03 SUBMITTALS

A. Prequalification Data: Provide prequalification data prior to the bid in accordance with Section 1.5 B. of this specification.

B. Shop Drawings: Provide shop drawings with a minimum size of 18" x 24" with a complete plan, elevation, and sectional views showing critical dimensions as follows:

i. Size, location, and number of all reinforcing bars.

ii. Thickness of all pars of the tank structure including floor, core wall, and covercoat.

iii. Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied force per foot of wall height.

iv. Location and details of all accessories required.

C. Concrete Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cementitious ratio in accordance with Section 2.02 and 2.03 of this specification.

D. Design Data: Submit structural calculations for the tank, signed and sealed by a professional engineer in accordance with Section 1.05 of this specification.

E. Coating Data: Submit color charts for review by the engineer and owner. Once a color is chosen, submit actual drawdown samples for final approval prior to application of coating.

F. Test Reports: Submit concrete strength reports for 7-day and 28-day breaks taken in accordance with the requirements.

G. Warranty Document: Submit warranty document in Owner's name in accordance with Section 1.06 of this specification.

H. Cleaning Plan: Submit a cleaning plan which complies with Section 3.04 of this specification.

I. Project Record Documents: Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

1.04 QUALITY ASSURANCE

A. Qualifications and Experience

i. Tank Construction Company: Shall be a firm with a minimum of three years of experience in the design and construction of ANSI/AWWA D110 wire-wound, circular prestressed concrete tanks with Type II core walls to ensure the owner that it has the organization, technical skill, quality control, reliability, and financial stability to build and guarantee the tank in accordance with the quality required by these specifications. The tank construction company shall have built with its own resources and have under warranty, a minimum of ten (10) prestressed concrete tanks of equal or greater size than that required for this project which meet these specifications and are now providing satisfactory service.

ii. Construction: The entire tank, including all portions of the floor and wall shall be built by the tank construction company, using its own trained personnel and equipment.

iii. Design: All design work for the tank shall be performed by a professional engineer with no less than five years of experience in the design and construction of ANSI/AWWA D110 wire-wound, circular prestressed concrete tanks with Type II core walls. The professional engineer shall be a full-time staff member of the tank construction company and shall be licensed to work in the state where the project is located.

iv. The diaphragm design and epoxy injection procedure shall have been used in the ten tanks required in Section 1.5 A.1 of this specification.

B. Prequalification

i. All tank construction companies must be prequalified and meet the criteria stated in Section 1.05 of this specification to be considered an acceptable tank builder.

ii. A complete prequalification package shall be submitted to the Engineer for consideration 14 days prior to the date set for receipt of bids. The prequalification submittal shall include the following items:

a. Complete construction drawings showing the principal sizes, thicknesses, reinforcing size, and spacing for all structural members including: floor and wall.

b. Complete details of other structural appurtenances as required by the project drawings showing principal sizes, thickness, and reinforcing sizes and spacing.

c. Complete design calculations which address applicable loads provided in Section 1.07 of this specification.

d. Complete experience record for the tanks used to meet the experience requirement of Section 1.05 of this specification that have been designed and built in the tank construction company's own name and shall include only those tanks that are under the company's warranty. The record shall include the size of the tank, name, address, and telephone number of the Owner, the year of construction and the name and telephone number of the Engineer for the project.

e. Experience in prestressed concrete tanks of the type specified herein for the construction superintendent, foreman, and three most experienced tank builders. Experience shall be with the bidder during the three previous years.

f. Construction schedule which details the duration for tank construction.

iii. The Following are preapproved as tank construction companies:

a. The Crom Corporation, Gainesville, Florida
b. Precon Corporation, Newberry, Florida

1.05 DESIGN CRITERIA

A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, ANSI/AWWA D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks with Type II core walls, and currently accepted engineering principles and practices for the design of such structures.

B. The following loadings shall be utilized in the design:

   i. Capacity: 352,000 Gallon

   ii. Dimensions: 50’-0” x 24’-0” SWD

   iii. Seismic Loads: Seismic forces and moments resulting from water sloshing and seismic accelerations of the tank wall and water loads shall be calculated in accordance with ACI 350.3 or ANSI/AWWA D110.

   iv. Soil Pressure: Earth loads shall be determined by rational methods of soil mechanics. Soil pressure shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.

   v. Wind Loads: Wind loads shall be considered in the design in accordance with ASCE 7.

C. Subbase: A granular base material shall be used beneath the membrane slab when the subgrade materials do not allow free drainage.

   i. The base material should consist of a clean, well-compacted, angular or sub-angular material with a minimum thickness of 6 in.

   ii. The gradation of the base material should be selected to permit free drainage without the loss of fines or intermixing with the subgrade material.

   iii. The maximum particle size of the base material should be limited to provide a relatively level working surface without potential intrusion of the base materials into the membrane floor slab concrete.

   iv. Base material should be compacted to 95 percent of the maximum laboratory density determined by ASTM D1557.

D. Floor: The design of the floor for the prestressed concrete tank shall conform to the following:

i. Concrete membrane floors shall be a minimum of 4 in. thick and have a minimum thickness of 8 in. of concrete over all pipe encasements and around sumps.

ii. A minimum percentage of 0.60% reinforcing steel shall be used in the membrane floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of 2 ft into the adjacent membrane floor.

E. Core Wall:

i. The wire-wound, prestressed concrete tank core wall shall be designed as a thin shell cylindrical element using shotcrete and an embedded, mechanically bonded, galvanized steel shell diaphragm.

ii. The design of the core wall shall take into account appropriate edge restraint. To compensate for bending moments, shrinkage, differential drying, and temperature stresses, the following minimum reinforcing steel shall be incorporated into the design:

a. The top 2 ft of core wall shall have not less than 1% circumferential reinforcing.

b. The bottom 3 ft of core wall shall have not less than 1% circumferential reinforcing.

c. Inside Face:

i. The inside face of the core wall shall utilize the diaphragm as effective reinforcing.

ii. Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

d. Outside Face:

i. Vertical reinforcing steel in the outside face of the core wall shall be: minimum of #4 bars at 12 in center to center.

ii. Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.

iii. The minimum core wall thickness shall be 3 1/2 in.

iv. Reinforcing steel used in the core wall shall be designed using a maximum allowable design tensile stress f_s of 18,000psi.

v. Allowable compressive stress in the core wall due to initial prestressing force, f_{gi}, shall be:

a. 1250 psi + 75ft psi/in. with 0.5 f'_{gi} maximum or less (where f'_{gi} is defined as compressive strength at time initial prestressing force is applied and t is the thickness of the core wall in inches).

b. Maximum of 2250 psi.

vi. Allowable compressive stressing in the core wall due to final prestressing force, f_g, shall be :

a. 1250 psi + 75t psi/in. with 0.45 f'g maximum (where f'g is defined as compressive strength required for final prestressing force and t is the thickness of the core wall in inches).

b. Maximum of 2025 psi.

F. Prestressing:

i. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire placed under high tension.

ii. A substantial allowance shall be made for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.

iii. The prestressing design shall conform to the following minimum requirements:

a. Working stress for the tank wall, fs, shall be a maximum of 115,000 psi.

b. The allowable design tensile stress in the prestressing wire before losses, fsi shall be 145,600 psi or no greater than 0.63 fu, where fu is defined as the ultimate strength of the wire.

c. Areas to be prestressed will contain no fewer than 10 wires per foot of wall for 8 gauge and 8 wires per foot of wall for 6 gauge.

d. A maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge will be allowed.

G. Wall Openings:

i. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall be no less than 18 in. above the floor slab. The prestressing wires required at the pipe elevation shall be distributed into circumferential bands immediately above and below the opening to maintain the required prestressing force while leaving an unbanded strip around the entire tank.

ii. Unbanded strips shall have a vertical dimension of no more than 36 in. unless an axi-symmetric shell analysis is performed to account for compressive forces plus shear and moments caused by displacement of the prestressing wires into adjacent bands.

PART 2 - PRODUCT

2.01 PERFORMANCE

A. Performance of the materials used in the tank construction shall conform to the minimum requirements of this specification.

B. Substitutions to the materials in this specification may only be made if submitted in writing and approved by the engineer.

2.02 CONCRETE

A. Concrete shall conform to ACI 301/301M.

B. All concrete shall utilize Type I/II Portland Cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. Admixtures other than air-entraining and water reducing admixtures will not be permitted unless approved by the engineer.

E. Coarse and fine aggregate shall meet the requirements of ASTM C33/C33M.

F. Concrete mixes used in the construction of the tank shall conform to the following:

Mix	Compressive Strength (psi)	Minimum Cement Content (lbs)	Maximum Aggregate Size (in)	Maximum W/C Ratio	Air Content (%)	Slump (in)
Floor	4000	560	¾	0.45	5%+/-1.5%	4”+/- 1.5”

2.03 SHOTCRETE

A. Shotcrete shall conform to the requirements of ACI 506.2 except as modified herein.

B. All shotcrete mixes shall utilize type I/II cement.

C. A maximum of 25% of cementitious material me be fly ash.

D. All shotcrete in contact with diaphragm or prestressing wire shall be proportioned to consist of not more than three parts sand to one part Portland cement by weight. All other shotcrete shall be proportioned to consist of not more than four parts sand to one part Portland cement by weight.

E. Admixtures will not contain more than trace amounts of chlorides, fluorides, sulfides or nitrates.

F. Fine aggregate shall meet the requirements of ASTM C33/C33M

G. Shotcrete mixes used in the tank construction shall conform to the following:

Mix	Compressive Strength (psi)	Maximum W/C Ratio	Air Content (%)	Slump (in)	Fiber Reinforcement (lbs/cyd)
Core Wall	4000	0.42	5%+/-1.5%	4”+/- 1”	0
Covercoat	4000	0.42	5%+/-1.5%	4”+/- 1”	2lb/cy*

2.04 PRESTRESSED REINFORCEMENT

A. The prestressing wire shall conform to the requirements of ASTM A821/A821M, Type B.

B. The prestressing wire size shall be 0.162 in. (8 gauge), 0.192 in. (6 gauge) or large, but no larger than 0.25”

C. The ultimate tensile strength, f_u shall be, 231,000 psi or greater for 8-gauge wire, 222,000 psi or greater for 6 gauge.

D. Splices for horizontal prestressed reinforcement shall develop the full strength of the wire.

2.05 NON-PRESTRESSED REINFORCEMENT

A. Non-prestressed mild reinforcing steel shall be new billet steel meeting the requirements of ASTM A615/A615M with a minimum yield strength, f_y, of 60,000 psi.

B. Welded wire reinforcing shall be plain wire conforming to the requirements of ASTM A1064/A1064M with a minimum yield strength, f_y, of 65,000 psi.

2.06 GALVANIZED STEEL DIAPHRAM

A. The galvanized steel diaphragm used in the construction of the core wall shall be 26 gauge with a minimum thickness of 0.017 in. conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G90 of Table 1 of ASTM A653/A653M.

B. The diaphragm shall be formed with re-entrant angles and erected so that a mechanical key is created between the shotcrete and diaphragm.

C. The diaphragm shall be continuous to within 3 inches of the top and bottom of the wall. Horizontal joints or splices will not be permitted.

D. All vertical joints in the diaphragm shall be rolled seamed, crimped and sealed watertight using epoxy injection.

E. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to the waterstop.

2.07 PVC WATERSTOPS, BEARING PADS, AND SPONGE FILLER

A. Plastic waterstops shall be extruded from an elastomeric plastic material of which the base resin is virgin polyvinyl chloride.

B. The profile and size of the waterstop shall be suitable for the hydrostatic pressure and movements to which it is exposed.

C. Bearing pads used in floor/wall joints shall consist of neoprene, natural rubber or polyvinyl chloride.

D. Sponge filler at the floor/wall joint shall be closed-cell neoprene.

2.08 EPOXY

A. Epoxy Sealants

i. Epoxy shall conform to the requirements of ASTM C881/C881M.

ii. Epoxy used for sealing the diaphragm shall be, Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy.

iii. Epoxy used for placing the waterstop shall be Type II, Grade 2, and shall be 100% solids, moisture insensitive, low exotherm epoxy.

iv. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.

v. The epoxy sealants used in the tank construction shall be suitable for bonding to concrete, shotcrete, PVC, and steel.

B. Bonding Epoxy

i. Epoxy resins used for enhancing the bond between fresh concrete and hardened concrete shall conform to the requirements of ASTM C881/C881M.

ii. Epoxy resins shall be a two-component, 100% solids, moisture-insensitive epoxy and shall be Type II, Grade 2.

2.09 SEISMIC RESTRAINT CABLES

A. When required by design, seismic restraint cables shall be seven-wire strand conforming to ASTM A416/A416M.

B. The strand shall be protected with a fusion-bonded, grit-impregnated epoxy coating conforming to ASTM A882/A882M.

C. The minimum ultimate strength of the seven-wire strand shall be 270,000 psi.

2.10 TANK ACCESSORIES

A. Minimum of one, 1' 5" x 4' 4" rectangular Type 316 stainless steel wall manhole for access to the interior of the tank. The cover shall also be of Type 316 stainless steel. The wall manhole shall be designed to resist hydraulic loading without excessive deflection.

B. Aluminum Accessories

i. Exterior stairs shall be fabricated from 6061-T6 and 6063-T6 aluminum and shall conform to all applicable OSHA standards.

ii. Aluminum handrail shall be fabricated in 20 ft typical sections from 6061-T6 aluminum and shall conform to all applicable OSHA standards.

iii. Aluminum accessories shall be shop fabricated and fully welded. All welding shall be in accordance with American Welding Society (AWS) standards using gas tungsten arc welding (GTAW) to fuse materials without distortion of the material. Mechanical splices shall only be used at field splice locations.

iv. Aluminum accessories shall have a "mill" finish.

v. Aluminum surfaces in contact with concrete shall be protected with a coat of bituminous paint.

C. Interior ladder shall be fabricated from fiberglass and shall conform to all applicable OSHA standards. The ladder shall have a safety climbing device manufactured from Type 316 stainless steel as required to meet applicable OSHA standards.

D. Through-wall pipe sleeves shall be Type 316 stainless steel sleeves with neoprene modular seal units.

E. Accessory hardware, unless otherwise noted, shall be Type 316 stainless steel conforming to ASTM F593.

2.11 COATINGS

A. Exterior coating system shall consist of one of the following:

i. Two coats Tnemec Series 156 Enviro-Crete Modified Waterborne Acrylate.

ii. Two coats Thoroseal Waterproof Cement-Based CoatinG

iii. Other approved equal

PART 3 - EXECUTION

3.01 EXAMINATION

A. All subgrade elevations shall be verified prior to starting tank construction.

3.02 INSTALLATION

A. Floor

i. The subgrade shall be prepared by fine grading to ensure proper placement of reinforcing steel with proper bottom cover

ii. A 6-mil polyethylene vapor-barrier shall be placed after subgrade preparation has been completed.

iii. Form and screed boards shall be of proper thickness and sufficiently braced to ensure that the floor is constructed within proper thickness tolerances.

iv. Plate bolsters shall be used to support reinforcing steel supported directly on the subgrade to ensure positive control of placement of reinforcing steel.

v. The floor shall be vibratory screed to effect consolidation of concrete and proper encasement of floor reinforcing steel.

vi. The floor shall be water cured for a minimum of 7 days after casting.

vii. The floor shall receive a light broom finish.

B. Core Wall:

i. The wall shall be constructed utilizing diaphragm and shotcrete with each conforming to the following:

a. Diaphragm Erection:

(1) The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be made in the diaphragm for erection except in the top 3 inches. Holes shall not be made in the diaphragm except

for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an epoxy sealant which complies with Section 2.8 Epoxy.

b. Shotcrete:

(1) All shotcrete shall be applied by or under direct supervision of experienced nozzlemen certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP-60.

(2) Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.

(3) No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.

(4) No less than ⅛ in. thick shotcrete shall separate reinforcing steel and prestressing wire.

(5) The diaphragm shall be encased and protected with no less than 1 in. of shotcrete in all locations.

(6) The interior shotcrete shall receive a light broom finish.

c. Curing:

(1) Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is completed.

C. Epoxy Injection

i. Epoxy injection shall be carried out from bottom of top of wall using a pressure pumping procedure

ii. Epoxy injection shall proceed only after the diaphragm has been fully encased, inside and outside, with shotcrete.

D. Prestressing:

i. The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating

the force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.

ii. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive force equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.

iii. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.

iv. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the design and as shown on approved drawings.

v. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include: electronic direct reading stressometer accurate to within 2%, calibrated dynamometers and a test stand to verify the accuracy of the equipment.

vi. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.

vii. When multiple layers of wire are required, shotcrete cover between layers shall be no less than ⅛ in. thick.

E. Covercoat:

i. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1 in. shall be placed over the prestressing wires.

ii. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.

iii. The covercoat shall receive a sliced trowel finish

F. Wall Openings:

i. All wall pipes, sleeves and manholes passing through the wall shall be sealed to the diaphragm by epoxy injection.

G. Coatings:

i. All coatings shall be applied a minimum of 28 days after final application of concrete or shotcrete.

ii. All application procedures for coatings shall be in accordance with manufacturer's recommendations.

H. Covercoat:

i. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1 in. shall be placed over the prestressing wires.

ii. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.

iii. The covercoat shall receive a sliced trowel finish.

3.03 FIELD QUALITY CONTROL

A. Inspection and Testing:

i. Concrete and Shotcrete Testing:

a. Compression Tests:

(1) Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 yards of concrete/shotcrete placed. Each set of test specimens shall be a minimum of 5 cylinders.

(2) Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test

cylinders. Test specimens shall be 6-inch diameter by 12-inch high or 4-inch diameter by 8-inch high cylinders.

(3) Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

b. Air Content Tests (concrete only):

(1) Air content tests shall conform to ASTM C231/C231M (Pressure Method for Air Content).

(2) Tests for air content shall be made prior to concrete placement and whenever compression test specimens are made.

c. Slump Tests (concrete only):

(1) Slump tests shall be made in accordance with ASTM C143/C143M.

(2) Slump tests shall be made whenever compression test specimens are made.

ii. Hydrostatic Testing:

a. The tank shall be tested for watertightness upon completion.

b. The testing for watertightness shall be completed as follows:

(1) Fill the tank with water to the maximum water level and let it stand for a minimum of 24 hours.

(2) Inspect the exterior of the tank wall and footing for damp spots. Damp spots shall be defined as spots where moisture can be picked up on a dry hand, the source of which is from inside the tank.

(3) Leakage through the wall or wall-base joint shall be repaired and the tank shall be retested using the above procedure.

3.04 FIELD QUALITY CONTROL

A. The interior of the tank shall be cleaned to remove debris, construction items, and equipment prior to testing.

END OF SECTION

SECTION 15560
TERTIARY CONCRETE FILTER
PILE CLOTH

PART 1 – GENERAL

1.01 SPECIFICATION PRECEDENCE

A. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. 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.

1.02 SERVICE

A. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of three (3) trips and eleven (11), eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance. The equipment manufacturer shall furnish the services of a factory trained representative for 1 trip and 3 eight hour days at the jobsite for performance testing.

B. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

1.03 WARRANTY

A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

1.04 MANUFACTURING QUALIFICATIONS

A. The filter supplier shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media.

PART 2 - PRODUCT

2.01 DISK TERTIARY FILTER

A. There shall be two (2) disk filters. Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the disk filter as shown on the drawings and as specified herein. Through the wall spool piping and all external piping shall be provided by the installing contractor. Effluent weir assembly shall be provided by the installing contractor.

Each unit will include:

a. Basin Mounting Brackets and Hardware
b. Drive Assembly
c. Centertube Assembly with Cloth Media Disks
d. Backwash System
e. Backwash/Waste Pump Assembly
f. Valves
g. Influent Weir
h. Pressure Transducer Assembly
i. Float Switch
j. Vacuum Transmitter
k. Electrical Controls with Internal Components

All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

2.02 PERFORMANCE AND DESIGN PARAMETERS

A. The Disk filter shall be capable of filtering effluent from an SBR process. Design shall be for:

1.0 MGD Average Daily Flow
2.0 MGD Maximum Daily Flow

B. Filter influent total suspended solids (TSS) concentration shall be 10 mg/l daily average and 20 mg/l maximum at average daily flow rate.

C. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.

D. Filter effluent turbidity shall not be greater than 3 NTU based on a daily average.

2.03 FILTER DISK BASIN

A. Each filter shall be installed in a concrete basin.

2.04 BASIN MOUNTING BRACKETS AND HARDWARE

A. Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with 304 stainless steel wedge anchors and hardware. Through the wall spool piping and all filter external piping shall be provided by the Installing Contractor.

2.05 DRIVE ASSEMBLY

A. Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 1/2 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.

B. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be approved. Belt drive systems or systems with multiple drive units per filter will not be approved.

C. If motors and gearboxes require routine maintenance, and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.

2.06 CENTERTUBE ASSEMBLY

A. Each centertube assembly shall include a minimum 3/16” thick 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk

segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials other than Viton are not approved for seal materials. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

2.07 FILTER CLOTH ASSEMBLIES

A. Each basin shall include ten (10) cloth disk assemblies. Each cloth disk assembly shall be comprised of two (2) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

B. Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth will not be approved.

C. Each filter unit shall have a total of: 108 square feet of minimum effective submerged filtration area.

D. Each cloth disk assembly shall have a minimum of 10.8 square feet of effective submerged filtration area. Effective submerged filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into no more than two (2) segments and shall be easily removable for service.

E. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.

F. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk

to the inside. Systems with flow paths from the inside to the outside of the disk that collect filtered solids and debris on the interior surfaces of the disk will not be approved.

G. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

H. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations

I. The operator shall be able to bring a drained filter on line by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.

J. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be approved.

K. Submittals shall include a hydraulic profile through the filter showing the following:
   a. Influent weir length
   b. Influent weir elevation
   c. Influent weir nappe at design and peak flow
   d. Effluent weir length
   e. Effluent weir elevation
   f. Effluent weir nappe at design and peak flow

2.08 BACKWASH SYSTEM

A. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two (2) backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.

B. The backwash filter basin must contain the anticipated volume of waste water produced by the plant when operating at design capacity. As this plant has two filters, the total volume of waste wash water using 15 minutes of backwashing at a rate of 20 gallons per minute per square foot.

C. The backwash system shall include 304 stainless steel backwash shoe supports with 316 stainless steel springs, UHMW backwash shoes, reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifold, and PVC sludge collection manifold. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be approved.

2.09 BACKWASH/WASTE PUMP ASSEMBLIES

A. Each backwash/waste pump assembly shall include two (2) backwash/waste pumps, valves, and gauges. In the external piping shall be backwash and solids waste valves, two (2), 3” recirculation ball valves, 3” manually operated flow control gate valve for each pump, vacuum gauges, and pressure gauges.

B. The backwash/waste pumps shall be shipped loose for field installation by the installing contractor. Backwash piping between the filter basin and pumps as well as piping following the pumps shall be supplied by the installing contractor. Installing contractor shall supply unions or flanges for service, and interconnecting wiring.

C. The backwash/waste pumps shall be a Gorman Rupp model 12B20-B or approved equal, externally mounted centrifugal pump. Pump shall be provided with a 2 HP, 460 volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 130 gpm at 24.3 ft TDH. Motor shall be Baldor, Teco, Weg or approved equal. Backwashing shall be initiated by basin water level, timer, or manually through the operator interface. Operator shall have the ability to specify backwash time interval elapses through the

operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted.

D. Pump manually operated threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80 and shall be Nibco or approved equal. The 3 inch threaded ball valves shall be a two-piece, full port, with a brass body. Valves and shall be Nibco or approved equal.

E. The vacuum gauges shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, ¼" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.

F. The pressure gauges shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, ¼" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.

G. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

2.10 VALVES

A. Each filter shall include three (3), 2" backwash valves. Valves shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

B. Because of fouling that can be caused by stringy material, non-full port valves such as butterfly valves or plastic valves will not be approved.

C. Each filter shall include one (1), 2" solids waste valve. Valve shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

D. Each filter shall include a solids waste removal system consisting of perforated manifold, mounted on the floor of the filter basin. The manifold shall be designed to siphon

settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be approved.

2.11 INDIVIDUAL FILTER ISOLATION

A. Each filter shall include isolation upstream provided by the installing contractor.

2.12 EFFLUENT WEIR BOX

A. Each filter shall include a 304 stainless steel effluent weir box. The weir box shall be mounted to the filter basin interior using 304 stainless steel wedge anchors and hardware. The basin wall must be smooth and plumb to facilitate a quality installation. Filter systems without effluent weir box will not be accepted.

2.13 PRESSURE TRANSDUCER

A. A submersible pressure transducer shall be supplied for each filter basin. The pressure transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Units shall monitor the water level in the filter basin. Pressure transducer shall be provided with a mounting bracket and stainless steel anchors. A bellows providing vented gage atmospheric reference shall be supplied for contractor installation in junction box. The installing contractor shall provide junction box, bellows mounting, and interconnecting wiring. Transducers shall be Keller Levelgage series or approved equal.

2.14 FLOAT SWITCH

A. A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing hermetically sealed and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

2.15 VACUUM TRANSMITTER

A. The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 1 standard atmosphere to full vacuum. Transmitter shall be an IFM Effector PX series or approved equal.

2.16 DISK MISC/SPARE PARTS

a. Frame and cloth assemblies (2)
b. Backwash/solids waste valve and actuator (1)
c. Viton V-ring effluent port/centertube seal (1)

2.17 CONTROL SYSTEM

A. The automatic and manual controls for operation of the filtration system shall be furnished fully assembled, wired, and pre-programmed in a UL 508A Certified Industrial Control Panel. Controls shall be provided to control or monitor equipment as described in the contract drawings. The control system shall include the following control components and practices.

2.18 CONTROL PANEL WIRING AND ASSEMBLY

A. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

B. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.

C. Wire colors are as follows:

208 VAC or higher	-	Black
120 VAC control power	-	Red
Neutral	-	White
Ground	-	Green
AC Power from remote source	-	Yellow
Neutral from remote source	-	White with Yellow Stripe
24 VDC (+)	-	Blue
24 VDC (-)	-	White with Blue Stripe
VDC (+) from remote source	-	Orange
VDC (-) from remote source	-	White with Orange Stripe
Intrinsically Safe	-	Light Blue

D. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

E. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

F. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

2.19 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1. Point to point testing of all wiring prior to application of power
2. Intended supply voltage shall be applied to the enclosure
3. All components shall be tested for proper operation and calibration
4. The PLC and operator interface program shall be loaded and functionally checked
5. All components shall be checked to confirm proper mounting specifications have been followed
6. Enclosure shall be inspected for defects and repaired if necessary
7. All labeling of wires and devices are correct, properly installed, and clean

B. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above. This document must be signed by Engineering, prior to release for shipment.

C. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

2.20 CONTROL ENCLOSURE

A. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (14 gauge) wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and

outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

B. The control enclosure shall be mounted remotely.

2.21 CORROSION INHIBITOR

A. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

2.22 MAIN DISCONNECT CIRCUIT BREAKER

A. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

2.23 MOTOR STARTER

A. A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection, and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

2.24 TRANSFORMER

A. A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

2.25 TRANSFORMER PRIMARY AND SECONDARY FUSE

A. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

2.26 CIRCUIT BREAKER

A. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

2.27 FUSE

A. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

2.28 OPERATOR DEVICE

A. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type push-to-test pilot lights and illuminated pushbuttons shall be provided for indication of an operation

status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

Amber – Alarm active, caution
Green – Valve open, motor running
Red – Valve closed
White - Information

B. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001, or approved equal.

2.29 HIGH FREQUENCY NOISE FILTER

A. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be an Islatrol IC+ or approved equal.

2.30 GROUND FAULT DUPLEX RECEPTACLE

A. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

2.31 24 VOLT DC POWER SUPPLY

A. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

2.32 CONTROL RELAY

A. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating, and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

2.33 TERMINAL BLOCK

A. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

2.34 PROGRAMMABLE LOGIC CONTROLLER

A. Automatic operation of the Filter shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L30ER or approved equal.

B. Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1769-PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4CI – Analog output (4 point) modules.

2.35 BASE UNIT

A. The base unit shall house embedded inputs, outputs, power supply, and communication (Ethernet, RS-232, RS-485) ports. The base unit shall also provide the interface to expansion I/O when required by an application.

B. Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse

protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL listed.

C. The embedded discrete inputs shall have an operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA, off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

D. The embedded discrete outputs shall have an operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

E. The embedded analog inputs shall have a Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

F. The embedded analog output shall have a Backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

G. The base unit shall have one (1) RS-232-C serial port, one (1) RS-485 serial port, and one (1) RJ-45 port which supports 10/100 Mbps EtherNet/IP. These ports shall be capable of local and remote programming, troubleshooting, and data manipulation.

H. The PLC base unit shall be an Allen Bradley 1769-L30ER or approved equal.

2.36 DIGITAL EXPANSION INPUT MODULE

A. The expansion digital input module shall have an operating voltage of 79 to 132V AC at 47 to 63 Hz. The module shall have an LED status indication of each point. The digital expansion input module shall be an Allen Bradley 1762-IA8 or approved equal.

2.37 MEMORY MODULE

A. The controller shall be shipped with a memory module for user program and data backup. The memory module shall be an Allen Bradley 1766-MM1 or approved equal.

2.38 ETHERNET SWITCH

A. An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface, and plant networking. The switch

shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation, and auto-polarity. Maximum distance for twisted pair cable shall be 100m.

B. The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Hirschmann/Spider 5TX, or approved equal.

END OF SECTION

SECTION 15570
SEQUENCING BATCH REACTORS (SBR) EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include unloading at the jobsite, handling, storage and installing of four SBR System including digester and post equalization equipment manufactured by Aqua-Aerobic Systems, Inc., of Rockford, Illinois or approved similar. Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the SBR system as shown on the drawings and as specified herein. Through the wall spool piping and all external piping shall be provided by the installing contractor.
The system shall include:

1. SBR EQUIPMENT
   - 2 15 HP Mixers with Moorings
   - 2 2.7 HP Sludge Pumps
   - 3 75 HP Blowers
   - 2 Influent Plug Valves
   - 2 Decanter Assembly
   - 2 Air Control Valves
   - 2 4-20 mA D.O. signals
   - 2 4-20 mA Pressure Transducers
   - 2 Level Sensors
   - 1 Common Alarm
   - 12 Retrievable Fine Bubble Diffusers
   - 2 Sludge Wasting Pump

2. DIGESTER EQUIPMENT
   - 1 10 HP Mixers with Moorings
   - 1 40 HP Blowers
   - 1 4-20 mA Pressure Transducers
   - 1 Level Sensors
   - 1 Fixed Coarse Bubble Diffuser System

3. POST SBR EQUIPMENT
   - 1 20 HP Blower
   - 1 4-20 mA Pressure Transducer
   - 1 Level Sensor
   - 1 Discharge Pressure Gauge
   - 1 Fixed Coarse Bubble Diffuser System

All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

B. Equipment installed 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.

1.02 MOTOR COMPLIANCE

A. Motors shall be in compliance with the Energy Independence and Security Act of 2007 (EISA 2007).

   a. All three phase motors and components shall be 460 volt, 60 hertz.
   b. All single phase components shall be 115 volt, 60 hertz.

1.03 INSTALLATION

A. The installation of the equipment furnished by the manufacturer shall be the responsibility of the installing contractor in accordance with all requirements of the contract documents.

1.04 SEPCIFICATION PRECEDENCE

A. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. 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.

B. The SBR area electrical classification shall be Nonclassified. Motors within the basin shall be rated for a temperature code T2A (280 Deg.C).

1.05 ACCEPTABLE MANUFACTURERS

A. These specifications and accompanying drawings are based upon the use of the AquaSBR® System and AquaDisk® System manufactured by Aqua-Aerobic Systems, Inc., 6306 North Alpine Road, Loves Park, IL, 61111, phone no. 815/654-2501, fax no. 815/654-2508.

1.06 SERVICE

A. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 3 trip(s) and 12 eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

B. The equipment manufacturer shall furnish the services of a factory trained representative for the Cloth Media Filter a maximum of 1 trips and 4 eight hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

C. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

D. The selected SBR manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant. The line shall connect to a live service technician who shall have the capability of connecting to the control panel via internet, with the operator's permission.

1.07 PERFORMANCE GUARANTEE

A. The single source supplier of the SBR and Cloth Media Filter System equipment shall provide a written Process Performance Guarantee to guarantee the SBR and Cloth Media Filter System will meet the effluent criteria specified under Section TBD of this specification section. The guarantee period shall commence at time of plant start-up, once the system has reached stable operation (or within six months of equipment shipment whichever first shall occur), and shall be in force for a period of one year. The Process Performance Guarantee shall be submitted as part of the engineer's submittal data.

1.08 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished by the City under this Section shall be submitted to the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Detailed drawings showing all of the details of construction pertaining to the filter screen system. This shall include installation details of all equipment associated with this system.

2. Detailed schematic and layout drawings and a description/narrative explaining the operation of all control panels.

3. All interconnections and interface requirements, dimensions, and locations of all major elements of the filter system including critical clearance requirements.

4. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design.

5. The startup/performance testing report and manufacturer's certification as required in Part 3.

1.09 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
5. IEEE, Institute of Electrical and Electronics Engineers
6. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.10 SYSTEM STARTUP

A. It is the responsibility of the contractor to coordinate with the filter system supplier/manufacturer for startup services upon completion of the systems installation. The following activities shall be provided by the manufacturer.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the filter system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 3 trips and 12 eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

5. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

6. The selected manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life cycle of the plant. The line shall connect to a live service technician who shall have the capability of connecting to the control panel via internet, with the operator's permission.

1.11 SBR FUNCTIONAL REQUIREMENT

A. The SBR shall be capable of treating influent from an inline pump station. Design shall be for the following parameters further described in the project description:

1.0 MGD Average Daily Flow
2.0 MGD Maximum Daily Flow

Design Loadings	Influent	Effluent
BOD	250	10
TSS	250	10
TKN	45	--
NH_3-N	--	0.5
Phosphorus	10	1

1.12 SYSTEM SOURCE & QUALITY ASSURANCE

A. The SBR System shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater treatment systems. The manufacturer's experience shall include a minimum of ten (10) installations where equipment of similar size and design has been in operation successfully in a similar process for a minimum of five (5) years. As a minimum, the supplier shall be the manufacturer of the following components: mixers, decanters, diffusers, and controls.

B. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the SBR System along with all other equipment and accessories as specified herein.

1.13 ELECTRICALLY ACTUATED VALVE QUALITY ASSURANCE

A. Actuated valves shall be tested to Aqua-Aerobic Systems test protocol prior to shipment or approved similar test. Testing shall consist of the following:

1) Project and nameplate data verification per assembly documentation
2) Limit switch and torque switch setup and cycle test
3) Hydrostatic test (two pressurization cycles) for all plug and butterfly valves

1.14 MIXER QUALITY ASSURANCE

A. The floating mixer(s) shall be shop inspected and tested prior to shipment. Testing shall consist of the following:

1) Project and nameplate data verification per assembly documentation.
2) Dynamic balancing
3) Final Inspection

1.15 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1) Point to point testing of all wiring prior to application of power.
2) Intended supply voltage shall be applied to the enclosure.
3) All components shall be tested for proper operation and calibration.
4) The PLC and operator interface program shall be loaded and functionally checked.

5) All components shall be checked to confirm proper mounting specifications have been followed.
6) Enclosure shall be inspected for defects and repaired if necessary.
7) All labeling of wires and devices are correct, properly installed and clean.

B. The manufacturer shall finalize the factory panel checkout by completing a controls checklist to document all testing completed above. This document must be signed by a Professional Electrical Engineer.

PART 2 - PRODUCTS

2.01 SBR STRUCTURE

A. The system shall be field erected in two basins as shown on the contract drawings:

Inside Dimensions:	-	59 ft. x 69 ft.
Side Water Depth:		
Minimum Operating Level	-	13.8 ft. SWD
Maximum Operating Level	-	22 ft. SWD
Top of Wall	-	24.5 ft.

2.02 INFLUENT PLUG VALVE

A. Furnish one (1), 12-inch diameter electrically operated flanged plug valve for each basin to control the influent flow.

B. Valves shall be flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an SA14.5, 460-volt, three phase, 60 cycle open/close service electric actuator. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size. Valve actuator shall include a compartment heater.

C. Each valve shall include a manual override with limit switch feedback to the micro-processor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

D. Provisions for valve access shall be provided by the installing contractor.

E. Each valve shall include a 10 ft. valve stem extension constructed of painted steel. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the installing contractor.

2.03 MIXER

A. Furnish one (1) mechanical floating mixer and related equipment accessories as described herein for each basin. Each mixer shall consist of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute. The mixer shall incorporate design enhancements that provide for five (5) years without routine maintenance (greasing).

B. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

2.04 MIXER DRIVE MOTOR (SBR)

A. The motor shall be rated for 15 horsepower at 900 RPM and wired for 460 volt, 60 hertz, three-phase service. The motor shall be standard efficiency, vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

B. The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A labyrinth seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.

C. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab

from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

D. Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

2.05 MOTOR MOUNTING BASE (SBR)

A. The motor shall be securely mounted onto a solid 304 stainless steel base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

B. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow, and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

2.06 IMPELLER (SBR)

A. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

2.07 INTAKE VOLUTE ASSEMBLY

A. The impeller shall operate in a volute made of 304 stainless steel plate, minimum 3/16 inch thick.

2.08 PIVOTAL MOORING SYSTEM

A. A pivotal mooring system shall be supplied for each unit consisting of a mooring arm extending from the basin sidewall to the unit. The pivotal mooring system including; adhesive anchors (if necessary), mooring cable, clips, thimbles, and quick disconnects

shall be supplied as shown on the drawings to assure a consistent location within the basin. Field attachment of the mooring assembly to the tank wall shall be the responsibility of the installing contractor.

2.09 PIVOTAL MOORING ELECTRICAL POWER CABLE

A. Each unit shall include power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with kellems grips at the motor and basin wall terminations. Electrical cable(s) shall be attached with cable ties provided by the equipment supplier. Attachment of the cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor

2.1 DECANTER ASSEMBLY

A. Furnish two 10x9 mechanical floating decanters and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless-steel movable weir assembly, and an electric motor driven actuator to open and close the weir.

B. Each decanter shall be capable of withdrawing decant fluid from 4 6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2 6 inches. The weir shall be circular in shape and permit liquid to enter the decanter from the entire 360 degrees without obstruction.

C. The weir shall be constructed of 304 stainless steel, be circular in shape, and shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft or linage which shall also function as the torque restraint.

D. Each unit shall be equipped with a modular float constructed of fiberglass filled with closed cell polyurethane foam having a minimum 2.0 lbs./ft^3 density. The minimum diameter of the float shall be 84 inches and the minimum thickness 12 ¼ inches. The float shall be completely sealed to prevent the foam from being in contact with the external environment. The float shall have 1833 lbs. reserve buoyancy to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

E. Maximum allowable water level in the basin is 22 ft. Minimum allowable water level in the basin is 13.6 ft. The centerline of each decant pipe must be located 1.6 ft. below the low water level by the installing contractor.

F. Each decanter shall be rated for an average flow of 5556 gallons per minute.

G. Weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force of 1500 lbs. and shall operate from a 115-volt, single phase, 60 hertz source. Adjustable limit switches shall be included to permit adjustment of the weir opening. A spring shall be included to provide for travel after the weir has closed and provide desired closure pressure. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation. The power section is painted steel. #14 AWG ten conductor power cable shall be provided from the NEMA 4X junction box of the unit to the basin wall. Supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

2.11 DECANTER DISCHARGE PIPE

A. Each decanter shall include a 304 stainless steel elbow with 16" diameter 304 stainless steel discharge pipe complete with Vanstone flange. The installing contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.

B. Each decanter shall include two 16" diameter stainless steel flex joints. Flex joints shall be constructed of 304L stainless steel flanges and 321 stainless steel bellows. Flex joints shall utilize heavy duty 304L stainless steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a minimum rating of 50,000 cycles per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be fully crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.

C. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing contractor.

2.12 DECANTER RESTRAINED MOORING SYSTEM

A. Furnished as part of the decanter assembly shall be a mooring frame, which shall permit the assembly to move up and down following the change in liquid level while restrained within the vertical pylons

B. Each decanter shall be moored with a restrained mooring system consisting of vertical pylon(s) with base plate and/or supports as specified above. Each pylon/support with

base plate shall be attached to the basin floor and filled with concrete by the installing contractor

C. Mooring post supports shall be provided for attachment to the basin wall by the installing contractor.

2.13 DECANT FLOW CONTROL VALVE

A. Furnish two 16" diameter electrically operated butterfly valves for each basin to control the decant rate.

B. Valves shall be a Milliken Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valves or approved equal, with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma SA10.1, 460 volt, three phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

D. Each valve shall include a 15 ft. valve stem extension constructed of painted steel. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the installing contractor.

2.14 SLUDGE TRANSFER PIPE

A. Furnish one submersible non-clog sludge pump for each basin. Each pump shall be equipped with 3.5 HP, submersible electrical motor connected for 460-volt, three phase, 60 hertz operation. Pump housing shall be painted cast iron. Pump shall include an adequate length of multi-conductor chloroprene jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron discharge elbow and be capable of delivering 225 GPM at 25 TDH. Each unit shall be fitted with an adequate length of galvanized steel lifting chain of adequate strength to permit raising and lowering the pump.

B. The 3" diameter discharge connection elbow shall be permanently installed with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin or pump well. Sealing

of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.

C. A galvanized steel upper guide bar bracket shall be provided with each pump. The entire weight of the pumping unit shall be guided by galvanized steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. No sealing of the discharge interface by means of a diaphragm, O-ring, or other devices shall be acceptable. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.

D. Supply of all discharge piping, supports, gaskets, and hardware beyond the flanged connection of the pump discharge connection elbow shall be the responsibility of the installing contractor.

E. Each pump shall include a manually operated discharge valve to control the design transfer flow rate.

F. Valve shall be a 3" diameter Milliken 601-N0, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size.

G. Each pump shall include a 3" diameter Nibco F-918-B check valve with cast iron body and bronze disk or approved equal to prevent backflow.

H. Valves shall be provided loose for installation within the discharge piping by the installing contractor. Valve gaskets and hardware shall be supplied by the installing contractor.

I. Adhesive anchors of 304 stainless steel shall be provided for anchoring the pump.

2.15 RETRIEVABLE FINE BUBBLE AIR DIFFUSER ASSEMBLIES (SBR)

A. Aeration may be used to help remove offensive tastes and odors due to dissolved gases from decomposing organic matter, or to reduce or remove objectionable amounts of carbon dioxide, hydrogen sulfide, etc., and to introduce oxygen to assist in iron and/or manganese removal.

B. The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the contract drawings. The aeration system shall be capable of delivering 1592 SCFM per basin.

C. A by-pass shall be provided for all aeration units. The aggressiveness of the water after aeration should be determined and corrected by additional treatment, if necessary.

D. Furnish six (6) retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. A total of 25 diffuser tube assemblies shall be provided for each diffuser rack. The diffuser assembly shall consist of two sheaths of ultraviolet inhibiting, EPDM material held in place by stainless steel band clamps over support pipes. Each diffuser shall be fixed to the stainless-steel air distribution manifold via one connection coupling. Each diffuser length shall require one air manifold boring and shall be secured by a mounting saddle/grommet fitting. Each meter of diffuser membrane shall have a minimum effective aeration area of 0.16 square meters. The diffuser design gassing rate shall not exceed 12.0 SCFM per diffuser assembly. The head loss through an individual diffuser shall not exceed 20" @ 6 SCFM. Upon the loss of air pressure, the perforations shall close and the membrane shall seat tightly over the air supply working as a check valve. The 4” diffuser manifold weldment shall be constructed of 304 stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

E. The vertical air column shall be constructed of galvanized steel. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, and a galvanized steel threaded flange, elbow and stainless steel quick disconnect adapters. All air distribution piping, gaskets, and hardware beyond the threaded flange shall be supplied by the installing contractor. The vertical track/beam assembly and intermediate supports shall be galvanized steel. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

F. Each assembly shall include a galvanized steel diffuser hoist assembly with base socket to receive a portable electric winch. A total of one (1) portable electric winch shall be provided for the diffuser assemblies. The winch mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a 115-volt, single phase, 60 hertz electrical supply rated for 12.6 full load amps. The winch shall be provided with a total of 8 feet of electrical cable. Supply of electrical power supply, wiring and junction box for winch shall be the responsibility of the installing contractor.

G. Each diffuser assembly shall include a 3" diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor. Valve gaskets and hardware are to be provided by the installing contractor.

H. Valve shall be a Wafer style butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece stainless-steel shaft.

I. All aerators except those discharging to lime softening or clarification plants shall be protected from contamination by birds, insects, wind borne debris, rainfall and water draining off the exterior of the aerators

J. Groundwater supplies exposed to the atmosphere by aeration must receive disinfection treatment as the minimum additional treatment.

2.16 BLOWERS (SBR)

A. There shall be furnished three (3) 75 HP, Roots 616, 460-volt, 60 cycle, three phase rotary lobe type, positive displacement blowers with premium efficient, T.E.F.C. U.S. Electric, Teco or equal motor. Each blower shall be capable of delivering 796 SCFM of air at a discharge gauge pressure of 11.1 psig. The blowers shall be manifolded for individual and/or combined operation.

B. Each blower assembly shall be complete and mounted on a base weldment with four corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled as much as possible to facilitate shipping and handling.

C. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, 10" butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

2.17 DISCHARGE PRESSURE GAUGE

Provide a discharge liquid filled pressure gauge to be equivalent to U.S. Gauge, Ashcroft, or approved equal.

Range: 0-15 psig.
Dial: 2 ½", 270 degree scale.
Case: 300 Series stainless steel.
Accuracy: ±3-2-3% of span (Grade B)

2.18 AIR CONTROL VALVES

A. Furnish a total of two (2) 8" diameter electrically operated butterfly valves to control the air flow.

B. Valves shall be a Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valves with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma, 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provision for valve access shall be provided by the installing contractor.

2.19 DISSOLVED OXYGEN CONTROLLER

A. Furnish one (1) Multi Parameter Probe Module(s) per basin. The probe shall receive the digital input from a maximum of two devices. The controller will communicate with the main PLC via 4-20 mA signals. The probe will have a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish and shall be AC powered from a 100-230VAC, 60Hz power source.

2.20 DISSOLVED OXYGEN SENSORS

A. Furnish one (1) dissolved oxygen sensor per basin. The probe shall be a continuous-reading probe utilizing luminescent sensor technology and shall provide electrolyte-free operation without requiring sample conditioning. Sensors shall be suspended on a removable mounting pipe assembly. 304 stainless steel pipe, 304 stainless supports and 304 stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

2.21 PRESSURE TRANSDUCER

A. Furnish submersible pressure transducer unit(s) constructed of stainless steel as specified herein. Transducer output shall be a 4-20 mA signal.

Quantity:	-	1 per basin
Model:	-	Keller Levelrat or approved equal

Mounting materials of Construction

Support Pipe:	-	304 stainless steel
Supports:	-	304 stainless steel
Anchors:	-	304 stainless steel

Basin Connection: - Adhesive anchors by System Manufacturer

B. Transducers shall be suspended on a removable assembly. Pipe, supports, and anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

C. Field attachment of the pressure transducer mounting brackets to the tank shall be the responsibility of the installing contractor. Adhesive anchors of 304 stainless steel shall be provided for anchoring.

2.22 POST-EQUALIZATION BASIN STRUCTURE

The Post-Equalization/Holding basin shall be field erected in one basin as shown on the contract drawings:

Inside Dimensions: 120 ft. x 21 ft.

Side Water Depth:

Minimum Operating Level:	1.5 ft. SWD
Maximum Operating Level:	11.5 ft. SWD
Top of Wall:	25 ft.

2.23 FIXED PVC COARSE BUBBLE DIFFUSERS (EQ BASIN)

A. Furnish one (1) fixed coarse bubble diffuser capable of 380 SCM for each basin. The diffuser system shall consist of diffusers, supports, manifold, and riser pipe. Diffuser pipes shall be not less than three-inch nominal diameter. Each diffuser section shall be supplied with uniformly-spaced machined orifices located on the top of each section. Size and number of orifices shall be provided to ensure a uniform air distribution.

B. Each diffuser section (and manifold pipe) shall be supported at span lengths not greater than 6 feet by supports. No unsupported end shall be longer than 2 ft. Diffuser sections shall be secured to the supports with a corrosion resistant retainer. Support brackets shall be adjustable to provide header leveling within ± 1/4 inch of a fixed elevation for each aeration basin.

C. Diffuser system shall be field assembled by the installing contractor. All submerged PVC joints 8" and smaller shall be socket welded joints. Expansion joints shall be included to compensate for thermal expansion for PVC manifold runs longer than 40 feet. Pipe

sizing, location and supports shall be as shown on the drawings. Diffuser sections and internal manifold piping shall have flange connections for disassembly.

D. The riser pipe shall terminate in a flanged connection at the top of the basin wall. All piping, gaskets, and hardware beyond the riser pipe's flanged connection shall be the provided by the installing contractor.

E. Attachment to the basin shall be the responsibility of the installing contractor.

2.24 BLOWERS (EQ BASIN)

A Furnish three phase rotary lobe type, positive displacement blowers as described below with premium efficient, T.E.F.C., Class F insulation, Teco, Siemens, or equal motor. The blowers shall be manifolded for individual and/or combined operation.

Blower Quantity:	One (1)
Motor Size:	20 HP
Manufacturer:	Roots
Model Number:	56
Airflow Rate:	380 SCFM per blower
Maximum Discharge Gauge Pressure:	6.2 PSIG
Inlet Configuration:	Separate filter and silencer
Discharge Isolation Valve Diameter:	4 inches
Seat Material:	EPDM

2.25 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of a float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting brackets for each basin. Each float switch shall be provided with a three-conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring the level sensor mounting bracket.

2.26 AEROBIC DIGESTER/SLUDGE HOLDING BASIN STRUCTURE

The Aerobic Digester/Sludge Holding basin shall be field erected in two basins as shown on the contract drawings:

Inside Dimensions : 41 ft. diameter

Minimum Operating Level:	15.4 ft. SWD
Maximum Operating Level:	22.0 ft. SWD
Top of Wall:	24.5 ft.

2.27 MIXER DRIVE MOTOR (DIGESTER)

A. The motor shall be rated for 10 horsepower at 900 RPM and wired for 460-volt, 60 hertz, three-phase service. The motor shall be standard efficiency, vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

B. The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A labyrinth seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.

C. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

D. Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

2.28 MOTOR MOUNTING BASE (DIGESTER)

A. The motor shall be securely mounted onto a solid base which is integral with the motor base extension. All submerged wetted mounting base components shall be constructed of 304 stainless steel.

B. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of

sealing off the flow of air from the suction action of the pumped flow and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

2.29 IMPELLER (DIGESTER)

A. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 or 15/5 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed.

2.30 FIXED PVC COARSE BUBBLE DIFFUSERS (DIGESTER)

A. Furnish one (1) fixed coarse bubble diffuser capable of 490 SCM for each basin. The diffuser system shall consist of diffusers, supports, manifold, and riser pipe. Diffuser pipes shall be not less than three-inch nominal diameter. Each diffuser section shall be supplied with uniformly-spaced machined orifices located on the top of each section. Size and number of orifices shall be provided to ensure a uniform air distribution.

B. Each diffuser section (and manifold pipe) shall be supported at span lengths not greater than 6 feet by supports. No unsupported end shall be longer than 2 feet. Diffuser sections shall be secured to the supports with a corrosion resistant retainer. Support brackets shall be adjustable to provide header leveling within ±¼ inch of a fixed elevation for each aeration basin.

C. Diffuser system shall be field assembled by the installing contractor. All submerged PVC joints 8” and smaller shall be socket welded joints. Expansion joints shall be included to compensate for thermal expansion for PVC manifold runs longer than 40 feet. Pipe sizing, location, and supports shall be as shown on the drawings. Diffuser sections and internal manifold piping shall have flange connections for disassembly.

D. The riser pipe shall terminate in a flanged connection at the top of the basin wall. All piping, gaskets, and hardware beyond the riser pipe’s flanged connection shall be provided by the Installing Contractor.

Attachment to the basin shall be the responsibility of the installing contractor.

2.31 SBR CONTOL PANEL WITHOUT MOTOR STARTERS

A. The control system shall be designed to optimize the SBR process 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.

B. 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.

C. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115-volt control circuit breaker, microprocessor control, operator interface display, indicator lights, and HAND-OFF-AUTOMATIC selector switches.

D. The incoming service of the control system shall be 115-volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for equipment indicated by an asterisk (*).

QTY	MINIMUM SBR EQUIPMENT DESCRIPTION
2	15 HP Mixers*
2	2.7 HP Sludge Pumps*
3	75 HP Blowers*
2	Influent Valves
2	Decanter Actuators
2	Decanter Valves
2	Air Control Valves
2	4-20 mA D.O. signals
2	4-20 mA Pressure Transducers
2	Level Sensors
1	Common Alarm

QTY	MINIMUM DIGESTER EQUIPMENT DESCRIPTION
1	10 HP Mixer*
1	40 HP Blowers*
1	4-20 mA Pressure Transducers
1	Level Sensors

QTY	MINIMUM POST SBR EQUIPMENT DESCRIPTION
1	20 HP Blower*
1	4-20 mA Pressure Transducer
1	Level Sensor

E. ENCLOSURE:

1. Free standing NEMA 12 steel enclosure - leg mounted.
2. Steel surfaces shall be cleaned, phosphate etched, and primed with a zinc rich enamel paint.
3. Finish paint shall be applied after all openings are completed and the surface is sanded and re-primed.
4. The exterior of the enclosure shall be painted with ANSI 61 Grey over a phosphatized surface.
5. The interior of the enclosure shall be painted white.
6. Lifting points shall be provided as required for convenient handling of the complete control enclosure.
7. The completed control panel shall meet NEMA 12 rating.
8. All seams shall be continuously welded and ground smooth.
9. All gasketing shall be oil resistant and securely held in place.
10. Dual door panels shall have a keyed handle operated three-point latching mechanism with roller latch rods (two keys shall be provided).
11. Doors shall be mounted using continuous heavy gauge piano hinge.
12. Door and enclosure stiffeners shall be welded into the enclosure as required to maintain flat smooth surfaces.
13. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.
14. Panel shall be UL listed and labeled.

F. CONTROL RELAYS: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating, 6 million mechanical life cycles and an operating temperature of -22°F to 131°F. Relays shall be Allen-Bradley 700-HK or approved equal.

G. GROUND FAULT DUPLEX RECEPTACLE: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 125VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be

overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

H. CONTROL PANEL WIRING COMPONENTS: All wires entering or leaving the control panel shall attach to the terminal strip. All control panel wire shall be 16 AWG multi-strand machine tool wire minimum. Insulation shall be MTW.

Wiring color continuation shall be:

120 VAC control power	-	RED
Neutral	-	WHITE
Ground	-	GREEN
Power from remote source	-	YELLOW
24-volt DC (+)	-	BLUE
24-volt DC (-)	-	BLUE W/WHITE STRIPE

All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

All terminals shall be strip mounted.
Voltage rating 600 volts.
Amperage rating 25 amps.
All terminals shall be numbered per the wiring schematic.
Wire terminations shall be tubular compression.

I. SWITCHES/PILOT LIGHTS: Selector switches shall be used on all automatic controlled equipment. Selector switches shall be rated NEMA 4X with contacts rated at 60 amp make, 6-amp break, 10 amp continuous. Pilot lights shall be 120/6-volt transformer type rated NEMA 4X. All switches and lights shall be clearly labeled with white plastic legend plates with black lettering.

J. PROGRAMMABLE LOGIC CONTROLLER: Automatic operation of the SBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a panel mounted rack or chassis, power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include an Ethernet and RS-232 communication port. All input and output points supplied (including unused) shall be wired to terminal blocks.

K. VENDOR/MODEL:

Allen-Bradley/ 1769-L30ER – Processor
Allen-Bradley/1769 – Chassis (# = 4, 7, 10 or 13 slots)
Allen-Bradley/1769-PA2 – Power Supply
Allen-Bradley/1769-IA16 – Discrete input (16 point) modules
Allen-Bradley/1769-OW16 – Discrete output (16 point) modules
Allen-Bradley/1769-IF8 – Analog input (8 channel) modules

L. DESIGN DESCRIPTION-1769-L30ER PROCESSOR:

Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class 1, Division 2 hazardous location certified, UL listed.

M. DIGITAL INPUT MODULE (16 POINT MODULE):

Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 11mA, off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL listed.

N. DIGITAL OUTPUT MODULE (16 POINT):

Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA, at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL listed.

O. ANALOG INPUT MODULE (8 POINT MODULE) :

Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL listed.

P. REMOTE ACCESS ETHERNET MODEM:

A cULus marked, remote access VPN gateway shall be supplied to securely connect to a PLC via the internet using an Ethernet port and a secure VPN tunnel. The gateway can be DIN rail or wall screw mounting and shall provide WAN/LAN 10/100 Mb Ethernet ports. The gateway shall be a Ewon Cosy + ETH.

Q. OPERATOR INTERFACE DISPLAY:

A. MINIMUM REQUIREMENTS: The operator interface shall be a NEMA Type 12, 13, 4X rated, 10.4” diagonal, color touchscreen display with Ethernet and serial

communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 800 x 600 pixel resolution. The rated operating temperature shall be 32° to 131° F. The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 10".

The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters: Process cycle current phase with time remaining in the phase, Cycle structure presets, Aeration cycle presets, Alarm condition annunciation, and Auxiliary equipment presets.

B. SCADA INTERFACE: Additional points shall be awarded for the provision of SCADA technology that includes, at a minimum: industrial computer with SCADA screens, controls, and indicators associated with SBR operations, and shall provide minimum information of:

a. Blower Operation
b. SBR Sequence, levels, and data
c. EQ Basin Operation
d. Do
e. Valving
f. Other parameters necessary or pertinent to the system

R. SOFTWARE: The PLC function shall be to control, sequence, and monitor the SBR.

PHASE CONTROL, the regulation of the process cycles of the SBR up to the maximum daily flow of the plant.

AERATION CONTROL, the regulation of the aeration and mixing systems to achieve optimum process control.

COMPONENT MONITORING, the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

PART 3 – EXECUTION

3.01 INSTALLATION OF EQUIPMENT

A. Supervision by a representative of the manufacturer shall be provided with regard to all mechanical equipment at the time of installation and initial operation.

3.02 OPERATING EQUIPMENT

A. The following shall be provided for plant operation:
    a. a complete outfit of tools and accessories;
    b. necessary laboratory equipment; and
    c. adequate piping with suitable sampling taps so located as to permit the collection of samples of water from critical portions of the units. Sampling taps should be located at the sludge withdrawal level and preferably spaced at two-foot intervals from the basin bottom to two feet below the effluent level.

3.03 CHEMICAL FEED

A. Chemicals shall be applied at such points and by such means as to ensure satisfactory mixing of the chemicals with the water. Interference between treatment chemicals and optimum locations and sequences for feeding different chemicals shall be considered.

END OF SECTION

D. ELECTRICAL SPECIFICATIONS

SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This division of the Specifications, Division 16 000, covers the complete interior and exterior electrical systems as indicated on the drawings or as specified herein. Provide all materials, labor, equipment, and supervision to install electrical systems.

1.03 QUALITY ASSURANCE

A. All electrical work shall be in accordance with the following codes and agencies:

1. The National Electrical Code (NFPA 70)
2. The National Electrical Safety Code (ANSI C-2)
3. The Life Safety Code (NFPA 101)
4. The International Building Code
5. Occupation Safety and Health Administration (OSHA)
6. Manufacturer’s written requirements.
7. Regulations of the local utility company with respect to metering and service entrance.
8. State and municipal ordinances governing electrical work.

B. Material Standards: All material shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and Standards of the organization listed below are applicable to materials specified herein.

1. American Society for Testing and Materials (ASTM)
2. Underwriters' Laboratories, Inc. (UL)
3. National Electrical Manufacturer Association (NEMA)
4. Insulated Cable Engineers Association (ICEA)
5. Institute of Electrical and Electronic Engineers (IEEE)
6. National Fire Protection Association (NFPA)
7. American National Standards Institute (ANSI)
8. Manufacturer’s Written Requirements

1.04 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.05 WARRANTY

A. The Contractor warrants to the Owner and Engineer those materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

1.06 DRAWINGS

A. The drawings indicate the arrangements of electrical equipment. Review civil drawings for door swings, cabinets, counters, and built-in equipment; conditions indicated on civil plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness.

B. Do not scale drawings. Obtain dimensions for layout of equipment from civil plans unless indicated on Electrical plans.

C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.

D. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the job differs from layout, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

1.07 SUBMITTALS:

A. Shop Drawings and Product Data:

1. The Contractor shall submit for review by the Engineer data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not

be acceptable. Provide complete electrical characteristics for all equipment. Submittals for lighting fixtures shall include Photometric data.

2. Refer to the individual sections for identified equipment and materials for which submittals are required.

3. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES section for required procedures.

B. Record Documents

1. Refer to Division 1 for record documents and related submittals.

1.08 OPERATION AND MAINTENANCE DATA AND INSTRUCTIONS

A. Refer to Division 1 for detail requirements.

B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.

C. Instructions of Owner Personnel:

1. Before final inspection, as designated by the Engineer provide a competent representative to instruct Owner's designated personnel in systems under this division of the specifications. For equipment requiring seasonal operation, perform instructions for other season within six months unless requested otherwise.

2. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

3. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.09 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service. Refer to ELECTRICAL CONNECTIONS FOR EQUIPMENT section for connection requirements.

B. Drawings indicate design loads and voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the Owner. Such adjustment shall be subject to the review of the Engineer.

C. Incidental items not indicated on Drawings or mentioned in Specifications but that can legitimately and reasonably be inferred to belong to the Work or be necessary in good practice to provide a complete system, shall be furnished and installed as though itemized here in detail. This includes connection requirements for air conditioning and refrigeration equipment as outlined by NEC Article 440.

1.10 SCHEDULING OF OUTAGES

A. Electrical work requiring interruption of electrical power which would adversely affect the normal operation of the other portions of the Owner's property, shall be done at time other than normal working hours. Normal working hours shall be considered eight A.M. to five P.M. Monday through Friday.

B. Schedule all work requiring interruption of electrical power two weeks prior to actual shutdown. Submit schedule in writing indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the approval of the Engineer and the Representative of the Owner.

1.11 SITE INVESTIGATION

A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment, or systems, shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be new.

B. Furnish all materials specified herein or indicated on the drawings.

C. Materials of the same type shall be the product of one manufacturer.

D. All materials shall be UL listed and shall bear UL label. ETL listed material shall bear ETL label. ETL label shall be accepted in lieu of UL when the UL testing standards have been followed.

PART 3 - EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Inspect materials upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material. Handle materials in accordance with manufacturer's applicable standards and suppliers

recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises.

B. All material, except items specifically designed to be installed outdoors such as pad mounted transformers or stand-by generators, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided by the Contractor. Provide temperature and/or humidity control where applicable. No material for installation, including conductors, shall be stored other than in an enclosed weathertight structure. Equipment stored other than as specified above shall be removed from the premises.

C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat and high humidity at all times. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.02 CLEANING AND PAINTING

A. Remove oil, dirt, grease and foreign materials from all raceways, fittings, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touchup scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.

B. Do not paint trim covers for flush mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinets unless required by the Engineer, National Electrical Code, or other Sections of the specifications. Remove trim covers before painting. Under no conditions shall locks, latches or exposed trim clamps be painted.

C. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.

D. Where plywood backboards are used to mount equipment provided under Division 16, paint backboards with two coats of light grey semi-gloss paint under Division 16.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform all excavation to install conduits, duct banks, and handholes indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. Provide shoring as required by OSHA Standards. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping. Do all excavation by open cut. No tunneling

shall be done unless indicated on the drawings or unless written permission is received from the Architect.

B. Grade the bottom of trenches to provide uniform bearing and support for conduits, or duct bank on undisturbed soil at every point along its entire length. Tamp overdepths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. Backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface to grade and compaction indicated on the drawings, mounded over and smoothed off.

3.04 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE.

A. Testing

1. Refer to the individual specification sections and the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of the specifications for test requirements.

2. Prior to the final inspection, the systems or equipment shall be tested and reported as therein specified. Five (5) typewritten copies of the tests shall be submitted to the Engineer for approval.

3. All electrical systems shall be tested for compliance with the specifications.

B. Manufacturers Certifications

1. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been reviewed by the manufacturer is installed in accordance with the manufacturer's recommendations and is operating in accordance with the specifications.

2. Provide manufacturers certification for the following systems:

a. Engine Driven EPSS.

C. Design Authority Assistance

1. The Contractor shall provide personnel to assist the Engineer or his representative during all construction review visits. The Contractor shall provide all necessary tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, radios, etc.

2. Remove equipment covers (i.e. panelboard trims, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.

3. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed by the Representative.

4. The Contractor shall provide authorized representatives of the manufacturers to demonstrate to the Engineer compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the Engineer. Refer to the specific specification section for additional testing requirements. Representatives of the following systems are required for demonstrations:

    a. Engine Driven EPSS

END OF SECTION

SECTION 16110
RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section covers the complete interior and exterior raceway system.

B. Definition: The term conduit, as used in this Specification, shall mean any or all of the raceway types specified.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:
   No. 1 Flexible Metal Electrical Conduit
   No. 6 Rigid Galvanized Conduit
   No. 6A Rigid Stainless Steel Conduit
   No. 467 Electrical Grounding and Bonding
   No. 651 Rigid Nonmetallic Electrical Conduit
   No. 797 Electrical Metallic Tubing
   No. 1242 Intermediate Metal Conduit

2. American National Standards Institute (ANSI):
   C-80.1 Rigid Galvanized Conduit.
   C-80.3 Electrical Metallic Tubing.

3. National Fire Protection Association (NFPA):
   No. 70 National Electrical Code (NEC).

4. Federal Specifications (Fed Spec):
   WW-C-581E: Conduit, Metal, Rigid; And Couplings, Elbow and Nipple, Electrical Conduit: Zinc Coated.
   W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.

1. Metallic Conduit Fittings:

   a. Appleton
   b. Carlon

c. Crouse Hinds
d. Killark
e. O-Z/Gedney
f. RACO
g. Thomas and Betts
h. Calbrite
i. Gibson
j. Or equal

2. Support Channel:

a. Kindorf
b. Powers
c. Unistrut
d. Or equal

3. Non-Metallic Conduit and Fittings:

a. Carlon
b. Certainteed
c. Thomas and Betts
d. Or equal

C. Coordination

1. Coordinate conduit installation with electrical equipment furnished.

2. Coordinate conduit installation with contract documents and other contractors. Adjust installation to eliminate conflicts. Review all shop drawings submitted under this and other sections to insure coordination with all equipment requiring electrical service and to avoid conflict interferences. Coordinate installation sequence with other contractors to avoid conflicts including equipment access and provide the fastest overall installation schedule.

1.04 STORAGE AND HANDLING

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section of the specifications for storage and handling requirements.

B. Non-metallic conduits stored on site prior to installation shall be stored on a surface off of the ground and shall be protected from the direct rays of the sun and from debris.

C. Damaged, oxidized, warped, improperly stored material or material with excessive amounts of foreign debris will be removed from the project and replaced with new materials.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All conduit and fittings shall be listed and bear a label by Underwriters' Laboratories (UL) for use as raceway system for electrical conductors.

C. Raceway is required for all wiring, unless specifically indicated or specified otherwise.

D. Size: The minimum size of conduit shall be 3/4". The size of all conduits shall be in accordance with the NEC, but, not less than indicated on the drawings. 3/8" flexible conduits may be used for connections between outlet box and lighting fixture only.

2.02 EMT CONDUIT FITTINGS

A. Electrical Metallic Tubing (EMT) couplings and connectors shall be steel "concrete tight" type. Malleable iron, die cast or pressure cast fittings are not permitted. Fittings 2.0" and smaller shall be gland and ring compression type. Connectors for conduits 2.5" and larger shall be set screw type with two (2) screws each or compression type. Couplings for conduits 2.5" and larger shall be set screw type with four (4) screws each or compression type. All connectors shall be insulated throat type. All set screw connectors encased in walls or floor shall be taped at all joints.

2.03 RIGID AND IMC CONDUIT FITTINGS

A. Fittings for rigid steel and IMC shall be standard threaded couplings, threaded hubs, locknuts, bushings, and elbows. All materials shall be steel or malleable iron only. Set screw or non-thread fittings are not permitted. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings. Erickson-type couplings may be used to complete a conduit run.

2.04 STAINLESS STEEL CONDUIT FITTINGS

A. Fittings for stainless steel shall be standard threaded couplings, threaded hubs, locknuts, bushings, and elbows. All materials shall be stainless steel. Set screw or non-thread fittings are not permitted. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings. Erickson-type couplings may be used to complete a conduit run.

2.05 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be Schedule 80 PVC.

B. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer.

C. Glue for all non-metallic conduit and fittings shall be provided as required by the manufacturer of the conduit being used.

2.06 CONDUIT SUPPORTS

A. For exterior locations provide 304 stainless steel channel, conduit clamps, threaded rod and hardware of equivalent dimensions identified for interior locations. For interior locations all parts and hardware shall be zinc-coated or have equivalent corrosion protection.

B. Conduit straps shall be single hole cast metal type or two-hole galvanized metal type.

C. Conduit support channels shall be 1.5" x 1.5" x 14 gauge galvanized (or with equivalent treatment) channel. Channel suspension shall be 3/8" threaded steel rods. Use swivel type connector to attach suspension rods to structure. Spring steel clips are not acceptable. Wire or chain is not acceptable for conduit hangers.

D. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose, sized appropriately for the conduit type and diameter, and have pre-assembled closure bolt and nut and provisions for receiving threaded hanger rod. Support with 1/4" threaded steel rod for individual conduits 1.5" and smaller and 3/8" rod for individual conduits 2.0" and larger.

E. Individual conduit straps on metal studs shall be spring steel and should wrap around entire face of conduit securely biting into both edges and have provisions for screwing into stud. Size appropriately for conduit to be support. Tie wraps are not acceptable.

F. Support multiple conduits from metal studs using pre-assembled bar hanger assembly consisting of hanger bar, retaining clips and conduit straps.

G. Refer to SUPPORTING DEVICES section of these specifications for additional material requirements.

2.07 FLEXIBLE CONDUIT AND FITTINGS

A. Flexible conduit shall be steel metallic type. Where specified herein, indicated on the drawings, or when used in damp or wet locations, as classified by the National Electrical Code, flexible conduit shall be liquid tight.

B. All flexible conduit shall be classified as suitable for system grounding. All flexible (liquid tight) conduits shall be UL listed as sunlight (UV) resistant.

C. Connectors for flexible conduit shall be steel insulated throat type rated as suitable for system ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.

D. Flexible conduit use for other than connections to lighting fixtures shall not be less than 3/4" trade size and in no case shall flexible conduit size be less than permitted by the National Electrical Code for the number and size of conductors to be installed herein. 3/8" flexible conduit may be used only for connection to lighting fixtures providing conduit fill requirements of the National Electrical Code are not exceeded.

2.08 MISCELLANEOUS CONDUIT FITTINGS AND ACCESSORIES

A. Vinyl all weather electrical tape for corrosion protection shall be Scotchrap 51 with two coats of Scotchrap pipe primer.

B. Expansion and deflection couplings shall be in accordance with UL 467 and UL 514. They shall accommodate ¾" deflection, expansion, or contraction in any direction and shall allow 30 degree angular deflections. Couplings shall contain an internal flexible metal braid to maintain raceway system ground continuity.

C. Fire and smoke stop materials shall be rock wool fiber, silicone foam, or silicone sealant, UL rated to maintain the fire floor or fire wall partition rating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings.

2. Leave all empty conduits with a 200 pound test nylon cord pull line

3. Install as complete raceway runs prior to installation of cables or wires.

4. Flattened, dented, burned, or deformed conduits are not permitted and shall be removed and replaced.

5. Secure rigid conduit i.e., rigid galvanized conduit and intermediate metal conduit, to sheet metal enclosures with two (2) locknuts and insulated bushing. Secure EMT to sheet metal enclosures with insulated throat connectors with lock nut.

6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on metal studs. Nails are not acceptable.

7. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage; any damaged conduits shall not be used.

8. Seal all conduits originating from outside building from below grade, all conduits entering refrigerated spaces, i.e., freezers and coolers, and all conduits entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture. Spray foam is not acceptable.

9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Architect by written authorization.

10. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer's recommendations and architectural specifications.

11. Install a complete SCADA Communications system as indicated on the drawings. The minimum conduit size shall be not less than 3/4". All bends in conduit shall be long sweep radius. Install no more than four 90 degree bends between pull or outlet boxes and backboard/cabinets.

12. Use flexible conduit for connection to vibrating equipment and rotating machinery and for connection from junction box to flush mounted lighting fixtures only.

13. Separate raceway systems are to be installed for power systems and for control, signal, and communications systems. Do not install control, signal, or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise on the drawings.

14. Provide expansion fitting in all conduits where length of run exceeds 200 feet or where conduits pass building expansion joints.

B. Uses Permitted

1. Conduits installed within concrete floor slabs which are in direct contact with grade or other material shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits which penetrate the building roof shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits installed within concrete floor slabs which are above grade shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC), or schedule 40 Heavy Wall PVC. Where transition is made from raceway in slab to any type of raceway out of slab, make transition with rigid galvanized elbow. For corrosion protection, where elbow penetrates surface, apply two (2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.

2. Rigid aluminum conduit may be used for all trades sizes where RGS or IMC is permitted. Do not install in direct contact with earth or concrete without corrosion protection.

3. Stainless steel conduits shall be used in highly corrosive areas where the conduit is subject to damage, specifically in the headworks/bar screen, odor control, grit removal, influent pump station and the SBR tanks.

4. Conduits installed in direct contact with earth shall be schedule 80, heavy wall PVC.

5. Service entrance conduits in direct contact with earth shall be galvanized steel. Other conduit in direct contact with earth shall be schedule 80, heavy wall PVC.

6. All other conduit, unless excluded herein, not permitted in accordance with the National Electrical Code, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT).

7. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the NEC.

8. Use flexible conduit for connections to motors, dry type transformers, unit heaters, and flush mounted lighting fixtures.

    a. Flexible conduit used for connection of motors, dry type transformers, unit heaters, shall not exceed 18" in length.

    b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6-ft. in length.

    c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.

    d. Liquid tight conduit shall be used to connect equipment in exterior installations.

9. Service entrance and feeder conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Service entrance conduits shall be installed "outside" of the building as defined by the NEC. Provide concrete encasement where required.

10. No conduit requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation. Conduits shall not be run horizontally in walls.

11. All conduits installed exposed from the finished floor to a minimum height of 10 ft. above the floor shall be galvanized rigid steel (GRS) or intermediate metallic conduit (IMC).

12. Where hazardous locations, as classified by the National Electrical Code, exist, all conduits and fittings and the installation of these materials shall comply with Article 500 of the National Electrical Code.

C. Below Grade Raceway Installations

1. Direct Burial Conduit

a. Install top of conduits 24" minimum below finished grade. Maximum depth shall be 36".

b. Install top of conduits 6" minimum below bottom of building slabs.

c. Install top of conduits 30" minimum below grade, below roads and any other paved surfaces.

d. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, make transition with rigid galvanized elbow and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, apply two (2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.

e. For excavation and backfilling, refer to earthwork specification section.

f. Conduit shall be run following the most direct route between points.

D. Raceway Installations Within Concrete

1. Conduit shall be run following the most direct route between points.

2. Conduit shall not be installed in concrete which is less than 3" thick or where the outside diameter is larger than 1/3 of the slab thickness.

3. Conduits installed in concrete slabs shall be buried in the concrete slab. Wire low conduits to upper side of the bottom reinforcing steel, and upper conduits to the lower side of the top reinforcing steel. Separate parallel runs of conduits within slab by at least 1".

4. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduits shall not be run directly below and parallel with load bearing walls

5. Protect each metallic conduit installed in concrete slab or conduits passing through a concrete slab against corrosion where conduit enters and leaves concrete by applying two (2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.

6. The maximum projection of conduit stub-up and bushing above slab shall be 3".

7. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

E. Concealed (Above Ceilings and in Walls) and Exposed Raceway Installation

1. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.

2. Support branch circuit conduits at intervals not exceeding 10 ft. and within three feet of each outlet, junction box, cabinet, or fitting. Attach individual branch circuit conduits to structural steel members with beam conduit clamps and to non-metallic structural members with one hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hangar rod and conduit clamp assembly. Multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

3. Attach feeder conduits larger than 1" trade diameter to or from structure on intervals not exceeding 12 ft. with conduit beam clamps, one hole conduit straps or trapeze type support in accordance with support systems described for branch circuit conduits.

4. Where conduits must pass through structural members, obtain approval of Engineer with respect to location and size of hole prior to drilling.

5. Conduits rigidly secured to building construction on opposite sides of a building expansion joint shall be provided with an expansion and deflection coupling. In lieu of an expansion coupling, conduits 2-1/2" and smaller may be provided with junction boxes on both sides of the expansion joint connected by 15" of slack flexible conduit with bonding jumper.

3.02 ADJUSTMENT, CLEANING AND PROTECTION

A. Clean: Upon completion, clean all installed materials of paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

B. All field cut threads of RGS or IMC conduits shall be painted with four coats of ZRC cold galvanizing compound. Allow compound to fully dry and cure between coats.

3.03 OUTSIDE CONDUITS

A. For all underground outside conduits, provide plastic locatable tape above. In addition, provide No. 6 (CU) 6” above conduits grounded at each end and 100 ft on center with 3” X 10ft copper clad ground rod.

END OF SECTION

SECTION 16120
WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of furnishing, installation, and connections of the building wiring system, 600 volts and below. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. Wiring systems for communication and alarm systems are not included in this section unless specified to be included, by reference, in the respective specification sections for alarm and communication systems.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:

No. 44: Rubber - Insulated Wire and Cables
No. 83: Thermoplastic - Insulated Wires
No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
No. 486: Wire Connectors and Soldering Lugs

2. Insulated Cable Engineers Association Standards (ICEA):

S-61-402: Thermoplastic Insulated Wire and Cable

3. National Electrical Manufacturer's Standards (NEMA):

WC-5: Thermoplastic Insulated Wire and Cable

4. National Fire Protection Association Publication (NFPA):

No. 70: National Electrical Code (NEC)

B. Acceptable Manufacturers. Products produced by the following manufacturers which conform to this specification are acceptable.

1. Hydraulically applied conductor terminations:

a. Square D
b. Burndy
c. Ilsco
d. Scotch (3M)
e. Thomas and Betts (T&B)
f. Anderson
g. Or equal

2. Mechanically applied (crimp) conductor terminations:

a. Scotch (3M)
b. Ideal
c. Thomas and Betts (T&B)
d. Burndy
e. Or equal

3. Vinyl electrical insulating tape:

a. Scotch (3M)
b. Tomic
c. Permacel
d. Or equal

4. Twist-On Wire Connectors:

a. Scotch (3M)
b. Ideal
c. Buchanan
d. Or equal

6. Portable cable fittings:

a. Crouse Hinds
b. Appleton
c. T&B
d. Or equal

7. Insulated Cable:

a. Brand-Rex Co.
b. Cablec Corp.
c. The Okonite Co.
d. Pirelli Cable Corp.
e. Senator Wire and Cable Co.
f. Southwire Co.
g. Houston Wire & Cable Co.
h. Aetna Insulated Wire Co.
i. American Insulated Wire Corp.
j. Or equal

C. Performance: Conductors shall be electrically continuous and free from short circuits or grounds. All open, shorted, or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All wire and cable shall be UL listed and shall bear a UL label along the conductor length at intervals not exceeding 24 inches.

C. All conductors shall have size, grade of insulation, voltage and manufacturer's name permanently marked on the outer cover at intervals not exceeding 24 inches.

D. Conductor size shall be a minimum of No. 12 AWG. Conductor size shall not be less than indicated on the drawings.

E. Insulation voltage level rating shall be 600 volts.

2.02 PRODUCT/MATERIALS DESCRIPTION

A. Conductors No. 10 AWG and smaller shall be solid copper, 90°C type THHN/THWN or XHHN, unless otherwise indicated on the drawings, required by the National Electrical Code, or specified elsewhere in Division 16.

B. Conductors larger than No. 10 AWG shall be stranded copper, 90°C, type THHN/THWN, XHHW, unless otherwise indicated on the drawings, required by the National Electrical Code, or specified herein.

C. Fixture wire shall be No. 16 AWG silicone rubber insulated, stranded fixture wire, type SFF-2 (150°C), or No. 16 AWG thermoplastic, nylon jacketed stranded fixture wire, type TFFN (90°C). Color code as specified herein shall not be required for fixture wire; however, neutral conductor shall be identified distinctly from phase conductors.

D. Control conductors for use on 120 volt control wiring systems shall be No. 12 AWG stranded type THHN/THWN, unless indicated otherwise on the drawings.

E. Splices and taps (No. 10 AWG and smaller) - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600 volt, 105°C. with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.

F. Splices and taps (No. 8 and larger) - Hydraulically applied crimping sleeve or tap connector sized for the conductors. Insulate the hydraulically applied connector

with 90°C., 600 volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location, voltage and temperature and shall not have an insulation value less than the conductors being joined.

G. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295.

PART 3 - EXECUTION

3.01 EXECUTION

A. Install all wiring in raceway system, except where direct burial cable or other conductors are indicated or specified not to be installed in raceway.

B. Connect all conductors. Torque each terminal connection to the manufacturers recommended torque value. A calibrated torqueing tool shall be used to insure proper torque application. Any conductors nicked or ringed while removing insulation shall be replaced.

C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings.

D. Conductors shall be tested to be continuous and free of short circuits and grounds.

E. Identification

1. Conductors within pull boxes shall be grouped and identified with nylon tie straps with circuit identification tag.

2. Identify each control conductor at its terminal points with wrap around tape wire markers. I.D. to indicate terminal block and point designation, or other appropriate identifying indication.

3. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional identification requirements.

F. Color Code Conductors.

1. Color code all secondary service, feeder, and branch circuit conductors. Control and signal system conductors need not be color coded.

2. Coding shall be as follows:

a. 208Y/120 volt three phase four wire wye system - Phase A: Black, Phase B: Red, Phase C: Blue, Neutral: White

b. 240/120V single phase three wire system – Phase A: Black, Phase B: Red, Neutral: white.

c. 480Y/277 volt three phase four wire system - Phase A: Brown, Phase B: Orange, Phase C: Yellow, Neutral: Gray

3. Grounding conductors shall be green.

4. Conductors No. 6 and smaller shall have solid color compound insulation or continuous color finish. Conductors No. 4 and larger shall have colored phase tape. Colored tape shall be installed on conductors in every box, at each terminal point, cabinet, through manhole or other enclosure.

G. Maintain phase rotation established at service equipment throughout entire project.

H. Group and lace with nylon tie straps all conductors within enclosures, i.e. panels, motor controllers motor control center, switchboard, switchgear, terminal cabinets, control cabinets.

I. Make splices in conductors only within junction boxes. Do not splice conductors in pull boxes, panelboards, safety switches, switchboard, switchgear, motor control center, wiring troughs or motor control enclosures.

J. Terminate conductors No. 10 AWG and smaller specified in Division 16 to be stranded, with crimp type lug or stud. Direct termination of stranded conductors without crimp terminator to terminal screws, lugs, or other points is not permitted even if terminal is rated for stranded conductors. Crimp terminal shall be the configuration type suitable for terminal point. Crimp lugs shall be applied in strict accordance with the manufacturer's written requirements.

K. Make connections between fixture junction box and fixture with fixture wire.

L. Control, communications, or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceway, unless indicated otherwise on the drawings.

M. Splices in conductors installed below grade are not permitted.

N. Secure portable cables provided with equipment (floating mixers, submersible pumps) in accordance with the NEC. Install strain relief devices to prevent tension on terminations if cable is pulled. Install cable grips on drops and connect to outlet box or structure. Leave slack cable loop at drop point.

END OF SECTION

SECTION 16130
BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of outlet boxes, pull boxes, and junction boxes throughout the wiring system including box supports.

B. Definition: Box, as used in this specification, includes all outlet, device, junction, and pull boxes. Feeder shall mean all conductor circuits larger than #8 AWG, including service entrance conductors, and all wiring above 600V.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:

No. 50: Electrical Cabinets and Boxes
No. 467: Electrical Grounding and Bonding Equipment
No. 514: Electrical Outlet Boxes and Fittings

2. National Fire Protection Association (NFPA):

No. 70: National Electrical Code (NEC)

B. Coordination: Review architectural drawings for areas where outlets occur within specific architectural or structural features and install outlets as shown on architectural drawings; or if not shown, accurately center and align boxes within the architectural features or detail.

C. Acceptable Manufacturers:

1. Exterior junction or pull boxes:

a. Pencel
b. Quaztite Type PC
c. Oldcastle Synertech
d. Or equal

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All boxes shall be UL listed and labeled.

C. Boxes shall be galvanized steel sheet metal, unless rustproof cast metal is specified or required by the NEC, or unless otherwise specified or indicated on the drawings.

2.02 OUTLET AND DEVICE BOXES

A. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be 4" octagon boxes, 1-1/2" deep.

B. Outlet boxes for flush mounted lighting fixtures shall be 4" square boxes 1-1/2" deep, with blank cover, installed adjacent to fixture. Connection to fixture shall be with flexible conduit and fixture wire.

C. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be 4" square boxes, 1-1/2" deep with square edge tile type cover. Where only one conduit enters box, 3-1/2" deep single gang switch box may be used. Outlet boxes for GFI receptacles shall be 2-3/4" deep.

D. Outlet boxes for switches and receptacles in exposed wiring system shall be cast FS boxes with matching device plate. Device plates for exterior installations shall be spring loaded hinged covers. Use FD box for GFI receptacle.

E. Outlet boxes for individual switches, and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3-1/2" deep.

F. Outlet boxes for support of surface or pendant mounted incandescent or HID lighting fixtures shall be provided with fixture stud.

G. Where special purpose device specified requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the installation required.

H. Outlet boxes installed in poured concrete or cast in place shall be concrete-tight type. The box depth shall allow 2" minimum of concrete cover.

2.03 JUNCTION AND PULL BOXES

A. Dimensions of pull boxes and junction boxes shall not be less than those dimensions required by the National Electrical Code for the number, size and position of conductors entering the box. Extension rings shall not be permitted on a box to increase the volume.

B. Pull boxes installed in finished spaces shall be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match panel trim for flush mounted electrical panelboard.

C. Pull boxes required for horizontal feeders containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" x 1-1/2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.

D. Provide box covers for all junction and pull boxes.

2.04 EXTERIOR JUNCTION OR PULL BOXES, FLUSH WITH GRADE

A. Junction or pull box to be mounted flush with grade shall be polymer concrete, open- bottom(self-draining) boxes with bolted cover lids. Box dimensions shall be as indicated on the drawings, sized in accordance with the National Electrical Code minimum requirements. Covers shall be polymer concrete secured to box with stainless steel bolts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All boxes shall be completely accessible and as required by the NEC. Provide access panels in any non-accessible spaces to allow access to boxes installed. Crawling above ceilings to access boxes is not acceptable.

B. Provide an outlet box for each lighting fixture and for each device. Boxes shall not be smaller than indicated in this section of the specifications and shall be larger if required by Article 314 of the National Electrical Code for the number and size of conductors installed. Where lighting fixtures are installed in continuous rows, only one outlet box shall be required.

C. Outlet boxes for flush mounted lighting fixtures shall be accessible. Where fixture installation is in non-accessible ceiling, outlet box shall be accessible when fixture is removed.

D. Set outlet boxes for flush mounted devices to within 1/8" of finished wall. Spacers or shims between box and device are not acceptable. Modification of boxes or use of extension rings to provide for 1/8” of finished wall is not acceptable.

E. Where low voltage device is to be installed in common outlet boxes with line voltage device, provide metal barrier within outlet box to establish two separate compartments.

F. Support every box from structure:

1. Secure to wood with wood screws.

2. Secure to hollow masonry with toggle bolts.

3. Secure to metal with sheet metal screws, machine bolts, or clamps.

4. Anchors for solid masonry and concrete shall be self-drilling expansion shields, insert expansion shields, or lead shields with machine bolts.

5. Secure outlet boxes to metal studs with spring steel clamp which wraps around entire face of stud and digs into both sides of stud. Clamp shall be screwed into stud.

6. Where box is suspended below structure, support from structure with threaded steel rod. Secure rod directly to outlet boxes with double nuts. For pull boxes larger than 18" x 18" x 6", construct 1-1/2" x 1-1/2" x 14 gauge metal channel frame. Connect frame to box by bolting and secure frame to threaded rod at each corner.

7. Hub type cast boxes need not be directly attached to structure if rigid conduit is used and supported in conformance with the NEC.

G. Support outlet boxes for support of surface mounted incandescent lighting fixtures by light weight channel spanning between and attached to main ceiling support member. Attach channel to ceiling support members with galvanized tie wire or nylon tie straps.

H. Do not use outlet boxes for support of LED fixtures; boxes shall be used only as junction boxes.

I. Remove only knockouts as required and plug all unused openings. Use threaded plugs for cast boxes and snap-in metal plugs for sheet metal boxes.

J. Outlet boxes in the same wall shall not be mounted back-to-back. Offset 6" minimum.

K. Install pull boxes only in unfinished spaces or concealed above ceilings, except when indicated on the drawings or approved by the Engineer.

L. Install pull boxes when any of the following conditions apply:

1. Where indicated on the drawings.

2. Where conduit run exceeds 200 ft. from box to box or box to terminal.

3. Where conduit contains more than 4-90 degree bends or the equivalent offsets.

4. To facilitate conductor installation or to insure that the manufacturer's maximum pulling tension is not exceeded.

5. As described in the RACEWAYS section of the specifications for crossing expansion joints.

M. Do not splice conductors in pull boxes. Splices are not permitted in pull boxes except when approved in writing by the Engineer or where shown on the drawings. Where splices are permitted, make splices with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.

N. Where a pull box is required, one shall be installed for each individual branch circuit conduit or each feeder. It shall contain only the feeder conductors or those conductors in the conduit. A combined pull box for multiple branch conduits or feeders is not permitted, unless approved by the Engineer or indicated on the drawings. Where permitted for multiple circuits within pull box:

1. Circuit conductors and feeders shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each circuit and feeder within pull box. Identify each with respect to load served.

2. Feeder circuits shall be separated by full height and length sheet metal or polyester resin barrier secured to box by angle brackets.

O. Box covers shall be in place and secured to box.

P. Identification

1. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional requirements.

Q. Exterior pull or junction boxes

1. Exterior pull or junction boxes shall be mounted flush with the grade, unless specified elsewhere or indicated to be aboveground on the drawings.

2. Flush mounted boxes shall be surrounded on all sides and bottom with 6" minimum of concrete. Top of concrete shall be flush with grade.

3. Seal conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

4. Taps and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin, and end sealing tape.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean all work of dirt, paint, and construction debris.

END OF SECTION

SECTION 16142
ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. To resistive heaters.

2. From electrical source to motor starters.

3. From motor starters to motors.

4. To lighting fixtures.

5. To transformers, and similar current adjustment features of equipment.

6. To master units of communication, signal, alarm, clock, public address, sound, and video systems.

C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division - 15 and other Division - 16 sections, and are work of this section.

1. Division 1 - GENERAL REQUIREMENTS

2. Division 11 – EQUIPMENT

3. Division 13 – SPECIAL CONSTRUCTION

4. Division 14 – CONVEYING SYSTEMS

5. Division 15 - MECHANICAL

D. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division - 16 sections, and are work of this section.

E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division - 16 sections, and are work of this section.

F. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

G. Electrical identification for wire/cable conductors is specified in Division - 16 section, ELECTRICAL IDENTIFICATION, and is work of this section.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches. NEC Article 110-14, "ELECTRICAL CONNECTIONS" applies to above.

B. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

C. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

1. ANSI/EIA RS-364-21A: "Insulation Resistance Test"

2. STD SG-14: "Unplated split-bolt and Vice-Type Electrical Connectors for Copper Conductors".

D. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.

1. STD. NO. 486A; Wire Connectors and Soldering Lugs for Use with Copper Conductors.

2. STD. NO. 486C; Splicing Wire Connectors.

3. STD. NO. 486D; Insulated Wire Connectors for Use With Underground Conductors.

E. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

F. ASTM Compliance: Comply with Standard B539 "Standard Methods for Measuring Contact Resistance of Electrical Connections (Static Contacts)."

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver electrical connection products wrapped in proper factory-fabricated type containers.

B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):

1. AMP Incorporated.

2. Appleton Electric Company.

3. Arrow-Hart Div, Crouse-Hinds Company.

4. Bishop Div, General Signal Corporation.

5. Burndy Corporation.

6. General Electric Company.

7. Gould, Inc.

8. Harvey Hubbell Inc.

9. Ideal Industries, Inc.

10. Reliable Electric Company.

11. Square D Company

12. Thomas and Betts Corporation.

13. Or equal.

2.02 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. Provide metal conduit, tubing and fittings of types, grades, sizes, and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division - 16 BASIC ELECTRICAL MATERIALS and RACEWAYS section, and in accordance with the following listing of metal conduit, tubing, and fittings:

a. Rigid steel conduit.

b. Rigid metal conduit fittings.

c. Electrical metallic tubing.

d. EMT fittings.

e. Flexible metal conduit.

f. Flexible metal conduit fittings.

g. Liquid-tight flexible metal conduit.

h. Liquid-tight flexible metal conduit fittings.

C. Wires, Cables, and Connectors:

1. Provide wires, cables, and connectors complying with Division - 16 basic electrical materials and methods section "WIRES AND CABLES".

2. Wires/Cables: Unless otherwise indicated, provided wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals which are recommended by equipment manufacturer for intended applications.

4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway, and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Maintain existing electrical services and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

E. Cover splices with electrical insulating material equivalent, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

F. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.

I. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

J. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subject to one or more of the following conditions:

    1. Exterior location.

2. Moist or humid atmosphere where condensate can be expected to accumulate.

3. Corrosive atmosphere.

4. Water spray.

5. Dripping oil, grease, or water.

K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase, and feeder number in accordance with Division - 16 section ELECTRICAL IDENTIFICATION. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

SECTION 16143
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work included under this section of the specifications consists of the installation of wiring devices, i.e. switches and receptacles and device plates. All materials shall be provided under this section of the specifications.

B. Select devices from lists of acceptable devices contained in this section of the specifications.

C. The catalog numbers listed herein for switches and receptacles are for items with brown finish. Notwithstanding catalog numbers, the switches and receptacles provided on this project shall have Ivory finish unless otherwise indicated. All special purpose receptacles shall be provided in black finish.

1.03 QUALITY ASSURANCE

A. NEMA WD-1 General Purpose Wiring

B. NEMA WD-5 Specific Purpose Wiring Devices

PART 2 - PRODUCTS

2.01 SWITCHES

A. Select switches from the following:

1. Single pole, 20 amp 277 volt switch: Arrow Hart 1991, Hubbell 1221, Leviton 53521, Pass & Seymour 20AC1.

2. Threeway, 20 amp 277 volt switch: Arrow Hart 1993, Hubbell 1223, Leviton 53523, Pass & Seymour 20AC3.

3. Weatherproof, 20 amp 277 volt switch: Arrow Hart 2991-2881G, Hubbell 1281-1750, Pass & Seymour 22515-4515.

4. Weatherproof, 20 amp 277 volt three way switch: Arrow Hart 2993/2881-G, Hubbell 1283-1750, Pass & Seymour 22535-4515.

2.02 RECEPTACLES

A. Select receptacles from those listed herein. Designation in parenthesis is NEMA configuration required.

1. 15 amp, 125 volt grounded duplex receptacle (5-15R): Arrow Hart 5262, Hubbell 5262, Leviton 5262, Pass & Seymour 5262.

2. 20 amp, 125 volt grounded duplex receptacle (5-20R): Arrow Hart 5739, Hubbell 5362, Leviton 5362.

3. Ground Fault Interrupter (GFI) 15 amp, 125 volt duplex receptacle: Leviton 6194, Arrow Hart 1591, Hubbell GF-5262, Pass & Seymour 1591-F.

4. Ground Fault Interrupter (GFI), 15 amp 125 volt duplex receptacle, through feed type: Arrow Hart 1591-F, Leviton 6399, Pass & Seymour 1591-F, Hubbell GF-5262.

5. Transient Voltage Surge Suppression (TVSS) receptacles shall comply with ANSI/IEEE C62.41 and UL1449 (3rd Ed.) for categories A and B. Devices shall provide RFI and EMI noise filtration of not less than a 7:1 reduction. Devices shall suppress transients in each of 3 modes: Line-to-neutral, line-to-ground, and neutral-to-ground. Devices shall be provided with an LED for positive indication of failure of protective circuitry or audible alarm. Products complying with this specification manufactured by Arrow Hart, Hubbell, Leviton, or Pass and Seymour are acceptable.

2.03 DEVICE PLATES

A. Device plates shall be one piece single or multi-gang type selected to match the device or combination of devices. Device plates for flush mounted devices shall be Type 302 stainless steel unless indicated otherwise.

1. Device plates for use with devices flush mounted in exposed masonry construction shall be jumbo type. Device plates for surface mounted devices shall be for use with the type of outlet box in which the device is mounted. All devices installed in areas exposed to the weather and where indicated on the drawings shall be provided with a weatherproof device plate.

2. Where engraved device plates are indicated on the drawings or specified in Division 16, engraving shall be done by the device plate manufacturer. All lettering shall be 1/8" high and shall be black unless other contrasting color is specified.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. The mounting height of devices are indicated in the legend on the drawings and is intended to mean the bottom of the device above the finished floor unless otherwise indicated on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.

B. Review Architectural Drawings for any device requiring specific location. Install receptacles above countertops with major axis horizontal above the backsplash.

C. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominate building feature, i.e., doorframes or countertops.

D. Install wall switches on the strike side of doors.

END OF SECTION

SECTION 16170
CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section covers disconnect switches for electrical equipment, 600V and below, and fuses mounted in the disconnect devices.

B. Furnish and install disconnect switches for any of the following conditions:

1. Where indicated on the drawings.

2. For all motors located out-of-sight of its motor controller.

3. For water heaters.

4. Where required by the National Electrical Code.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:

No. 98: Enclosed Switches

No. 198.2: High-Interrupting Capacity Fuses, Current Limiting Type

No. 198.4: Class R fuses

2. National Fire Protection Association (NFPA) Publications:

No. 70: National Electrical Code (NEC)

3. National Electrical Manufacturers Association (NEMA) Publications:

No. KS 1: Enclosed Switches

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:

1. General Electric

2. Eaton

3. Square D

4. Siemens

5. Or equal

C. Coordination: Coordinate installations with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure disconnect switch access and ensure that clearance minimums are provided.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. Furnish all materials specified herein.

B. All disconnects, and fuses shall be UL listed and bear a UL label.

C. Fuses shall be heavy duty, type HD horsepower rated as required for motor load served.

D. Switches shall be 600 volt rated, except for use in system below 240 volt, when they may be 250 volt rated. Switches shall be heavy duty rated. General duty switches are not acceptable.

E. Furnish a solid neutral for each switch being installed in a circuit which includes a neutral conductor.

F. Furnish an equipment grounding conductor lug bonded to the switch enclosure.

G. Disconnect switches shall be non-fusible safety switch, unless fused type is specified or indicated on the drawings, with the number of poles required to disconnect all ungrounded conductors serving equipment.

H. Enclosure shall be NEMA Type One in all interior dry locations and shall be NEMA Type 4X stainless steel in all damp, wet, or exterior locations, unless other type is indicated on the drawings or specified herein.

2.02 PRODUCT/MATERIAL DESCRIPTION

A. Switching mechanism shall be quick-make, quick-break type.

B. Where non-fused disconnect switches are indicated on the drawings or specified for use as disconnects, they shall be the non-fused type.

C. Switches shall have the following features:

1. Provide line terminal shields in all switches.

2. Each switch shall have provisions for padlocking in the "OFF" position.

3. Each switch shall have door interlocks to prevent door from being opened when switch is in closed position. Provide inconspicuous means to defeat interlock mechanism.

4. Provide permanent nameplate indicating switch rating in voltage, amperes and horsepower.

5. Arch chute for each pole.

D. Disconnect switches for three phase motors rated two horsepower and above shall be three pole nonfusible type rated as indicated on the drawings. Disconnect switches for three phase motors rated below two horsepower shall be three pole manual motor starter switches without overload protection. Disconnect for single phase motors shall be single or two pole horsepower rated switches without overload protection.

E. Fusible switches through 600 amp shall be provided with rejection clips to accept RK1 or RK5 class fuses only. Fusible switches larger than 600 amp shall be suitable for class L fuses. Furnish and install a complete set of fuses in each disconnect sized as indicated on the drawings. Fuses serving predominantly motor or transformer loads shall be dual-element, time delay type, otherwise non-time delay fast acting type is required. Fuses shall be current limiting with 200,000 AIC.

F. Disconnect switches for motors controlled by variable frequency drives shall be equipped with a normally open auxillary contact. The auxillary contact shall be wired into the control voltage stop/start circuit on the drive. The auxillary contact shall be early break, so that the start stop circuit drops out before the disconnect power circuit opens, and late make so that the disconnect power circuit closes before the start circuit on the drive is closed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate disconnect switches to maintain line of sight and to provide working clearance and full accessibility as required by the National Electrical Code.

B. Unless indicated otherwise on the drawings, locate disconnects adjacent to equipment served.

C. Lace and group conductors installed in disconnect with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond 1/8" from terminal lug.

D. Mounting and Support

1. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.

2. Mounting

a. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.

b. Attach enclosure directly to masonry, concrete, or wood surfaces.

c. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure, sheet metal equipment enclosure, or sheet rock walls.

d. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure. Refer to the detail on the drawing for frame installation and construction information.

e. Mount switch with handle between 36" and 60" above floor or grade, unless otherwise indicated on the drawings.

E. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to disconnect and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.

F. Conductors not terminating in disconnect shall not extend through or enter disconnect enclosure.

G. Install push-in knock-out closure plugs in any unused knock-out openings.

H. Identification

1. Disconnect switches shall be identified.

2. Refer to the ELECTRICAL IDENTIFICATION section of the specifications for identification requirements.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint, and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division - 16 sections.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers.
2. Riser clamps.
3. C-clamps.
4. I-beam clamps.
5. One-hole conduit straps.
6. Two-hole conduit straps.
7. Round steel rods.
8. Expansion anchors.
9. Toggle bolts.
10. Wall and floor seals.

C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment are specified as part of that equipment assembly in other Division - 16 sections.

D. For exterior locations, provide stainless seel supports, anchors and straps.

E. Provide seismic support for electrical equipment as required by IBC and Authority Having Jurisdiction.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

B. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

C. UL Compliance: Provide electrical components which are UL-listed and labeled.

PART 2 - PRODUCTS

2.01 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" diameter hole for round steel rod; approximately 54 lbs. per 100 units.

2. Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears; approximately 510 lbs. per 100 units.

3. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8"; black steel; approximately 16 lbs. per 100 units.

4. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 lbs. per 100 units.

5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 lbs. per 100 units.

6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 lbs. per 100 units.

7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.

8. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 lbs. per 100 units.

9. Round Steel Rod: Black steel; 1/2" diameter; approximately 67 lbs. per 100 feet.

10. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 lbs. per 100 units.

11. Provide stainless steel supporting devices for exterior locations and where specified.

C. Anchors: Provide anchors of types, sizes and materials indicated, with the following construction features:

1. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 lbs. per 100 units.

2. Expansion sleeve anchors by Hilti or Phillips Redhead: 1/2"; approximately 38 lbs. per 100 units.

3. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:

a. Ackerman Johnson Fastening Systems Inc.

b. Hilti

c. Ideal Industries, Inc.

d. Joslyn Mfg and Supply Company

e. McGraw Edison Company

f. Phillips Redhead

g. Rawlplug Company Inc.

D. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:

1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

E. U-Channel Strut Systems:

1. Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" diameter holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel.

a. Fixture hangers.

b. Channel hangers.

c. End caps.

d. Beam clamps.

e. Wiring studs.

f. Thinwall conduit clamps.

g. Rigid conduit clamps.

h. Conduit hangers.

i. U-bolts.

2. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

a. Allied Tube and Conduit Corporation.

b. B-Line Systems, Inc.

c. Elcen Metal Products Company.

d. Greenfield Mfg Company, Inc.

e. Midland-Ross Corporation.

f. OZ/Gedney Div; General Signal Corporation.

g. Power-Strut Div; Van Huffel Tube Corporation.

h. Unistrut Div; GTE Products Corporation.

3. Provide stainless steel channel for exterior locations and where specified.

2.02 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14" gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

3. Iron Pipe: Fabricate from cast-iron or ductile-iron pipe.

4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

B. Sleeve Seals: Provide modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports in compliance with NEC requirements.

D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

E. Remove burrs from ends of pipe sleeves.

END OF SECTION

SECTION 16195
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Extent of electrical identification work is as outlined by this specification.

B. Types of electrical identification work specified in this section include the following:

1. Buried conduit warnings.

2. Electrical power, control, and communication conductors.

3. Operational instructions and warnings.

4. Danger signs.

5. Equipment/system identification signs.

C. Refer to Division 1 General Requirements section IDENTIFICATION SYSTEMS, for equipment and system nameplates, and performance data; not work of this section.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

B. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

C. ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1, "Scheme for the Identification of Piping Systems".

D. NEMA Compliance: Comply with applicable requirements of NEMA Std No's WC-1 and WC-2 pertaining to identification of power and control conductors.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical identification materials and products.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):

1. Almetek
2. Brady, W.H. Company
3. Calpico Inc.
4. Cole-Flex Corporation
5. Direct Safety Company
6. George-Ingraham Corporation
7. Griffolyn Company
8. Ideal Industries, Inc.
9. LEM Products, Inc.
10. Markal Company
11. National Band and Tag Company
12. Panduit Corporation
13. Seton Name Plate Company
14. Tesa Corporation

2.02 ELECTRICAL IDENTIFICATION MATERIALS

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color-Coded Plastic Tape:

1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.

a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.

C. Underground-Type Plastic Line Marker:

1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick.

D. Cable/Conductor Identification Bands:

1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic-coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

E. Plasticized Tags:

1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

F. Self-Adhesive Plastic Signs:

1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.

2. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

G. Baked Enamel Danger Signs:

1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black, and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

H. Engraved Plastic-Laminate Signs:

1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for

mechanical fastening except where adhesive mounting is necessary because of substrate.

2. Thickness: 1/8", except as otherwise indicated.

3. Fasteners: Self-tapping stainless-steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer, or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC and OSHA.

2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

C. Box Identification:

1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits and a red marker for emergency circuits.

D. Underground Conduit Identification:

1. During back-filling/top-soiling of each exterior underground electrical, signal or communication conduit, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.

2. Install line marker for every buried conduit.

E. Cable/Conductor Identification:

1. Apply cable/conductor identification, including voltage, phase, and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work. Refer to WIRES AND CABLES section of these specifications for color coding requirements.

F. Operational Identification and Warnings:

1. Wherever required by OSHA or directed by the Owner, to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

G. Danger Signs:

1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work or the Owner as constituting similar dangers for persons in or about project.

a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.

b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

H. Equipment/System Identification:

1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/-control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:

   a. Panelboards, electrical cabinets, and enclosures.

   b. Access panel/doors to electrical facilities.

   c. Major electrical switchgear.

   d. Motor control centers.

   e. Transformers.

   f. Power generating units.

   g. Automatic transfer switch.

   h. Power transfer equipment.

2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.

3. Panelboards, individually mounted circuit breakers, and each feeder breaker in the distribution panels or motor control centers and each cubicle of the motor control center shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum 1/4" high letters.

   a. 480/277 volt normal power equipment shall be identified with white faceplate with black core.

   b. 480/277 volt emergency power equipment shall be identified with white faceplate with red core.

   c. 208/120 volt normal power equipment shall be identified with black faceplate with white core.

d. 208/120 volt essential power equipment shall be identified with red faceplate with white core.

e. Equipment identification is to indicate the following:

1) Equipment ID abbreviation.

2) Voltage, phase, wires and frequency.

3) Emergency or other system.

4) Power source origination. Example:

a) Panel E3HA

b) 480/277V, 3 phase, 4 wire

c) Emergency System

d) Fed by SWBD-7

f. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

END OF SECTION

SECTION 16210
ENGINE DRIVEN EMERGENCY POWER SUPPLY SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of one generator, and the purchase and installation of an automatic transfer switch; to provide a complete engine driven emergency power supply system. All materials and devices which are an integral part of this system shall be provided under this section of the specifications.

B. Definition: The Emergency Power Supply System (EPSS) shall consist of one or more engine driven generator sets, each of which contains an engine directly coupled to an electric generator, together with the necessary switchgear, controls, accessories, transfer devices and fuel supply to provide electric power for the duration of any failure of the normal power supply.

1. Automatic Transfer Switch (ATS): An automatic transfer switch is self-acting equipment for transferring one or more load conductor connections from one power source to another.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this specification by reference.

1. National Fire Protection Association (NFPA):

a. NFPA-37 Combustion Engines

b. NFPA-70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701 and 702,

c. NFPA-110 Emergency and Stand-By Power Systems. The generator set shall meer all requirements for Level 1 Systems. Level 1 prototype tests shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

2. Electrical Generating Systems Association (EGSA) Standards:

a. EGSA CEP2 Codes for Emergency Power by States and Major Cities

b. EGSA GTD3 Glossary of Standard Industry Terminology and Definitions

c. EGSA ECB1 Performance Standard for Engine Cranking Batteries

d. EGSA TSS1 Performance Standard for Transfer Switches for use with Engine Generator Sets

e. EGSA BCES1 Performance Standard for Battery Chargers

f. EGSA ICAE1 Performance Standard for Electric Generator Set Instrument Control and Auxiliary Equipment

3. Institute of Electrical and Electronics Engineers (IEEE) Standards:

a. IEEE 446 IEEE Recommended Practices for Emergency and Standby Power Systems for commercial and industrial applications.

b. IEEE 472 Voltage Surge Withstand Capabilities

4. National Electric Manufacturers Association (NEMA) Standards:

a. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.

b. ICS1-109 Test and Test Procedures for Automatic Transfer Switches

c. ICS 10-2005 Part 1 A.C. Automatic Transfer Switch

5. Underwriters Laboratories Inc. (UL) Publications:

a. UL 1008 Automatic and Non-Automatic Transfer Switches

b. UL508. The entire control system of the generator set shall be UL 508 listed and labeled.

c. UL142 – Sub-base Tanks

d. UL 1236 – Battery Chargers

e. UL2200 – The generator set shall be listed to UL2200 or submit to an independent third-party certification process to verify compliance as installed.

6. American National Standards Institute (ANSI):

    a. C37.90a Voltage Surge Withstand Capability

7. The control system for the generator set shall comply with the following requirements.

    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. FCC Part 15, Subpart B.

    e. IEC8528 part 4. Control Systems for Generator Sets

    f. IEC Std 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.

8. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:

1. Engine Driven Generator Sets:

    a. Cummins

    b. Caterpillar

2. Automatic Transfer Switches:

    a. Cummins OTPC Series

    b. ASCO 7000 Series

3. Sub-Base Fuel Tanks:

    a. Pryco

    b. Simplex

    c. Generator manufacturer

4. Provide aluminum work/service platform for the generator, it shall extend down both sides of the generator and across the end opposite the radiator exhaust. The platform shall have a structural aluminum frame, aluminum grating and aluminum hand rails. It shall be 4’ wide throughout and the elevation shall be equal to the top of the fuel tank. Provide aluminum steps at the center aisle (between the generators) toward the service road, provide handrails on the steps. Provide a concrete foundation for the work platform and steps.

C. Equipment Dimensions:

1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where equipment of acceptable manufacturers listed exceeds the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination:

1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications, and electrical equipment to ensure access and clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.

B. Manufacturer's Product Data:

1. Submit material specifications and installations data for products specified under Part 2 - Products to include:

a. Engine driven generator sets

b. Sub-base fuel tanks

c. Transfer switches

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Submittals containing less than the information listed below will be rejected.

1. Shop drawings for the engine driven generator sets shall contain not less than the information listed as follows:

a. Certification that the engine driven generator set(s) furnished will serve electrical loads indicated including motor starting loads with type(s) of starting indicated.

b. Stand-by rating of engine driven generator set(s) including voltage and phase.

c. Frequency and voltage regulation with maximum voltage dip and time of recovery to stable operation.

d. Output voltage adjustment range in percentage of rated plant voltage.

e. Alternator type and method of connection to prime mover.

f. Components contained in alternator instrument panel.

g. Rating of engine at operating speed, engine cycle and number of cylinders.

h. Type of engine lubrication system and verification of components specified.

i. Type of engine governor.

j. Components contained in engine instrument panel.

k. Fuel consumption at ¼, ½, ¾ and full load.

l. Starting batteries including ampere hour rating.

m. Verification that all accessories specified is to be provided. This includes cold weather starting aid with rating and voltage indicated, exhaust system with muffler type indicated, and outdoor housing (where applicable) with verification of space available within housing for batteries.

n. Line and machinery constants of the generator furnished.

o. Terminal board connection diagram where reconnectable generators are specified.

p. Circuit breaker type, rating, A.I.C. rating and cable capacity of lugs.

q. Parallel switchgear.

2. Shop drawings for the transfer switch shall contain not less than the information listed as follows:

a. List of accessories contained in the control panel.

b. Withstand rating in RMS symmetrical amperes.

c. Dimensions and access requirements.

D. Quality and Service:

1. All materials and parts of the EPSS shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment.

a) Units and components offered under these specifications shall be covered by the manufacturer's parts and labor warranty for a minimum of five (5) years from date of Owner acceptance of the project on a new machine, a copy of which shall be included in the shop drawings submittal.

2. Submittals will be accepted only on engine driven generator sets and transfer switches which can be properly maintained and serviced without requiring the Owner to stock spare parts or wait longer than twenty-four hours for service.

3. Submittals shall include the nearest location of permanent parts outlet from which parts may be obtained and written assurance that trained service personnel will be available on twenty-four hour's notice.

E. Record Drawings

1. Include in each set three sets of operating, maintenance, and parts manuals covering all components for the EPSS. Provide instructions to the Owner in operation and maintenance of his equipment, both in written form and with on-site personnel for a minimum of six hours.

PART 2 - PRODUCTS

2.01 ENGINE DRIVEN EMERGENCY POWER SUPPLY (EPS)

A. Engine

1. The engine driven emergency power supply (EPS) shall be an internal combustion diesel driven prime mover. The generator set shall have the following characteristics:

a. 800 KW Capacity

b. 1000 KVA Capacity

c. 480/277 Volts

d. 60 Hertz

e. 0.8 Power Factor

f. 3 Phase

g. 4 Wire

2. Maximum one-step load at 0.8 P.F. is 255.1 KW (step 1). The load to be served by this generator set consists of 566.9 KVA non-inductive load plus 1205 total motor horsepower. The motors shall be started as shown in the following table:

Sequence	Horse Power/KW/KVA	Code Letter	Starting Method
a. Initial Load			
Panel HA	100.6 KVA	NA	NA
Panel HB	38.6 KVA	NA	NA
Panel HC	6.0 KVA	NA	NA
Panel HD	11.7 KVA	NA	NA
Panel HF	11.7 KVA	NA	NA
b. SBR Blowers No. 1	50 HP	B	VFD
c. SBR Blowers No. 2	50 HP	B	VFD
d. Digester Blower No. 1 PE Blower	40 HP	B	VFD
	40 HP	B	VFD
e. In-Line Pump No. 1	30 HP	B	RVSS
In-Line Pump No. 2	30 HP	B	RVSS
f. Influent Pump No. 1	25 HP	B	VFD
g. Influent Pump No. 2	25 HP	B	VFD
h. SBR Mixer No.1	15 HP	B	RVSS
SBR Mixer No.2	15HP	B	RVSS
Digester Mixer	15 Hp	B	RVSS
i. Sludge Pump No.1	3 HP	B	FVNR
j. Sludge Pump No.2	3 HP	B	FVNR
k. Sludge Pump No.3	3 HP	B	FVNR

3. Provide load shed controls in plant SCADA system to match loading shown. In event of one generator out of service, SCADA system shall monitor load to not overload system.

4. The rated net horsepower of the engine at the generator synchronous speed, with all accessories, shall not be less than that required to produce the KW specified in paragraph 1 above. The horsepower rating shall take into account generator efficiency and all accessory losses such as fans, battery charger, etc. The generator set shall be capable of producing the specified KW (without overload) for the duration of the power outage, under the following ambient conditions:

a. Altitude: 10 feet above mean sea level.

b. Air temperature at engine intake: 104 degrees F.

c. Humidity Range: 40 - 95%.

5. Included with the shop drawing submittal shall be the manufacturer's estimate of supply fuel and oil consumption for each engine. Each engine shall have an oil filter with replaceable elements, a lube oil cooler, and an oil reservoir.

6. The engine shall be equipped with a suitable governor (engine speed control) to maintain frequency within limit specified below by controlling engine and generator speed. Manufacturer shall indicate in submittal data whether mechanical, hydraulic, electrical, or hybrid governors are provided.

   a. Type: Isochronous

   b. Stability: + ¼% maximum steady state frequency variation at any constant load from no load to full load.

   c. Regulation: 5% maximum frequency deviation between no-load steady state and full load steady state.

7. The engine shall be electric start, provided with a solenoid energized motor with either positive engagement or clutch drive to the engine.

8. The engine starting batteries shall be sealed lead-acid recombination type. Batteries shall be rack mounted inside the weatherproof plant housing to minimize the distance from the batteries to the starter.

   a. Provide battery straps and battery heater.

9. A float type battery charger, compatible with the batteries selected, shall be furnished at the engine which shall maintain the starting batteries at full charge.

10. It shall have an equalize rate and a float rate charging system. An ammeter and voltmeter shall indicate the charge rate and the circuit shall be protected by either fuses or circuit breakers. The charger or charging circuit shall be so designed that it will not be damaged during the engine cranking cycle, for example, by a current limiting charger or a crank disconnect relay. It shall also be capable of recharging a discharged battery in 12 hours while carrying normal loads. The charger shall be equipped with alarm relays as required for remote annunciation equipment.

11. The engine shall be liquid cooled. The type of liquid cooling system shall be unit mounted radiator - consideration shall be given for air temperature rise across the engine in addition to ambient. Minimum

capacity shall be rated for 104°F. minimum engine ambient temperature plus air temperature rise across the engine.

a. Provide two electric heaters, thermostatically controlled, in the engine coolant system as a cold weather starting aid. Heater shall be for operation on 120 volt single phase A.C. for 2500 watt units and below and on 208/240 volt single phase A.C. for all other units and shall be permanently connected to a circuit from the building electrical system. Heater shall maintain 70°F. to 90°F. Provide isolation valves or quick connect couplings for jacket water heaters.

12. Air Supply/Exhaust System

a. Cleaner: An air cleaner and silencer shall be furnished, located, and mounted as recommended by the engine manufacturer.

b. Exhaust: An exhaust system of suitable size, configuration, and material in accordance with engine manufacturer's recommendations shall connect the exhaust outlet of the engine to a silencer. The type of silencer shall meet the requirements of engine manufacturers and shall be industrial. The silencer shall be located inside outdoor enclosure.

c. The exhaust system including silencer shall be of such size that back pressure on the system will not exceed the back pressure permitted by the engine manufacturer's recommendation. A flexible connection shall be mounted at the engine exhaust outlet and the discharge end shall be protected against entry of precipitation. For piping rising up through the roof, provide condensation drip leg with valve at pipe elbow. Piping and silencer within reach of personnel or with 8'-0" of finished floor or grade shall be protected by screening and shall be insulated with two inches of calcium silicate insulation with aluminum jacket. All exhaust piping shall be gas tight.

13. The engine instrument panel shall be mounted at the engine and shall contain the following:

a. Oil pressure gauge to indicate lubricating oil pressure.

b. Temperature gauge to indicate cooling medium temperature.

c. Hour meter to indicate total actual running time.

d. Battery charging meter to indicate satisfactory performance of battery charging means.

e. Other instruments as recommended by the manufacturer for proper maintenance.

f. Manual stop/start controls: All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified.

B. Generator

1. The generator shall be an engine-driven single or two bearings type, synchronous, brushless, and conforming to applicable standards. It shall be connected to the engine flywheel by means of a flexible type coupling for single bearing generators and elastic coupling for two bearing generators.

2. The generator shall be rated for 40□C ambient. Class of insulation shall be NEMA Class F. The voltage regulation shall be plus or minus 2% from no load to full load with plus or minus 5% speed change and a 15□C. rise in ambient. The generator voltage dip from no load to full load shall not exceed 22%.

3. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

4. Provide 120 volt condensation heater in windings.

C. Voltage Regulation

1. The generator shall be equipped with a volts-per-hertz type voltage regulator to maintain voltage within limits specified below:

a. Stability: ½ % maximum voltage variation at any constant load from no load to full load.

b. Regulation: 4 % maximum voltage deviation between no load steady state and full load steady state.

c. Transient: 30 % voltage dip or overshoot on one-step application or removal of 0.8 power factor full load.

D. Generator Full Main Line Adjustable Circuit Breaker

1. A main line adjustable electronic circuit breaker with ground fault shall be supplied to protect the generator and controls from overloads and/or short circuits in the load. It shall be rated as indicated on the drawings. Breakers shall comply with UL 489 and NEMA AB-3. Breaker shall be rated at 2500 Amps with adjustable settings set at 1600 Amps.

E. Start and Stop Controls

1. Automatic starting and stopping controls shall be furnished to start the engine automatically when the normal electrical power fails or falls below specific limits and to stop the engine automatically after the normal power supply resumes. The signal for starting or stopping the engine shall be sensed through an auxiliary contact in the existing automatic transfer switch. The controls shall be capable of operating at 50% of normal DC system supplied voltage.

2. The cranking cycle shall be initiated by manual start, loss of normal power at the existing transfer switch, clock exerciser, or the manually operated test switch at existing ATS.

3. Crank control and the time delay relays shall provide a minimum of 4 crank attempts of at least 7 seconds each, separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at the completion of the starting program, the overcrank signal shall indicate. The engine starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset.

4. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" position that permits the engine to be started manually by the pushbutton on the control cabinet and run unloaded; an "automatic" position that readies the system for automatic start or stop on demand or the automatic load transfer switches or of the programmed exerciser.

5. A remote manual stop station similar to a break-glass station shall be provided at the new generator and existing transfer switch and shall be tied into the engine controls to stop the engine when activated. Provide laminated plastic label with 1/4" minimum engraved letters to read "EMERGENCY GENERATOR SHUTDOWN". Background to be red and core to be white.

F. Instrumentation

1. Remote and local engine control and safety panels shall be provided, containing the following:

   a. Automatic remote start capability.

   b. "Manual-Off-Auto" switch.

   c. Controls to shut down and lock out the prime mover under the following conditions: failure to start after specified cranking time, overspeed, low lubricating oil pressure, high engine temperature and operation of remote manual stop station.

d. Battery powered individual alarm indication to annunciate visually at the control and safety panel the occurrence of any condition itemized below; contacts or circuits for a common audible alarm signaling locally and remotely the occurrence of any itemized conditions listed below. Test switch shall be provided to test the operation of all lamps. Remote panel may be silenced in similar fashion to fire alarm control panel.

1) Indicator Function, Level 1 (At Battery Voltage):

	Control Panel Mounted Visual Indication	Shutdown of EPS	Remote Audible
a) Overcrank	X	X	X
b) Low Water Temp. < 70°F (21°C)	X		X
c) High Engine Temp. Pre-alarm	X		X
d) High Engine Temp.	X	X	X
e) Low Lube Oil Pressure Pre-alarm	X		X
f) Low Lube Oil Pressure	X	X	X
g) Overspeed	X	X	X
h) Low Fuel Main Tank	X		X
i) EPS Supplying Load	X		X
j) Control Switch Not In Auto Pos.	X		X
k) Battery Charger Malfunctioning	X		X
l) Low Voltage in Battery	X		X
m) Lamp Test	X		
n) Contacts for Local & Remote			
o) Common Alarm	X		X
p) Audible Alarm Silencing Switch			X
q) Remote Emergency Stop	X	X	X
r) Ground Fault Indication (400KW and greater)	X		X
s) Fuel in containment	X		X

2) Controls to shutdown the prime mover upon removal of initiating signal or manual emergency shutdown.

3) A.C. voltmeter with selector switch off position and positions for phase to phase and phase to neutral.

4) A.C. ammeter with selector switch with positions for each phase.

5) Frequency meter -- digital electronic type.

6) Voltage adjusting to allow plus or minus 5% voltage adjustment.

7) Manual reset circuit breaker.

8) Manual stop/start control.

9) Elapsed time meter.

10) Panel lights.

11) Indicator lights for signals from engine instrument panel.

12) Light to indicate switch has been left in the "off" position.

13) Light to indicate remote start.

14) Provide surface remote annunciator where shown on the drawings.

2. All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified. All instrumentation must be isolated from engine generator set vibration.

G. Enclosures and Connections:

1. All electrical enclosures, i.e., terminal cabinets, wire ways, circuit breaker enclosures, etc., shall be of adequate size to provide minimum bending radius as required by the NEC and measured from the terminals directly to the opposite wall of the enclosure, for the size conductor actually terminated within or passing through the enclosure.

2. All factory provided enclosures shall have gasket and finish appropriate for the environment in which the unit is to be mounted. All wiring, wiring harness, etc., shall be protected from the elements, such as direct sunlight, moisture, etc. or shall be UL listed for direct exposure to the applicable elements. Include written documentation of the above with the shop drawing submittal.

H. Provide flexible fuel connections at supply at return piping. Flexible hoses shall be steel reinforced type. Provide solenoid valve in series with gate valve in supply line. Solenoid valve shall be powered from generator batteries and shall be open only when generator is running.

I. Provide a 80 amp, 2 pole, 208 volt main breaker, single phase, three wire panel board mounted in generator enclosure attached to generator frame. Panel board shall include equipment ground bar and circuit breakers required for generator control circuits and weather starting aids etc. Quantity of breakers shall be determined by generator manufacturer with 25% spare breakers included. Service voltage – 208/120 volts, 1-phase 3-wire.

2.02 TRANSFER SWITCH(ES)

A. Transfer switch(es) shall be rated at not less than as indicated on the drawings at rated voltage. Transfer switch(es) shall be rated and marked for total system load.

B. Transfer switch(es) serving 480V three phase four wire loads shall be four poles with a switched neutral. Neutral contacts must be on the same shaft as the associated main contacts and have the same continuous current rating and withstand current rating. Neutral contacts shall break last and make first.

C. Transfer switch(es) shall be automatic, open-transition type.

D. Transfer switch(es) shall be floor mounted in a NEMA one enclosure. Enclosure shall have hinged door with three point latching and factory installed key locking enclosure.

E. Installation shall be for front and rear accessibility for all components as well as load, normal and emergency power terminals up to and including 4000 amp switch size. Where transfer switch power connections are made to busway or switchboard bus connections shall be made with bus; otherwise connections shall be with 90°C insulated cables. Transfer switch shall be installed in separate compartment, isolated from other electrical equipment by metal barriers. Control panel containing transfer switch control components shall be on compartment door. All control wiring between control panel and transfer switch shall be installed and tested for compliance with operational requirements prior to shipment. The interconnecting wiring harness shall include a disconnect plug to disconnect all wires including both sources of control power for routine maintenance.

F. Operation shall be inherently double-throw whereby all contacts move simultaneously. Electrical spacing shall be equal to or exceed those listed on Table 15.1 of UL-1008. Only those main contact structures specifically designed for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position. A manual operating handle shall be provided. All main contacts shall be silver alloy type protected by arc quenchers and, for switches rated 600 amps and larger, by arching contacts. Operating transfer time shall be 1/10 second or less on switches rated 600 amps and above.

G. All switch and contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panel from the enclosure and without disconnecting power conductors or drive linkages. Control and sensing relays shall be continuous duty industrial type with minimum contact rating of ten amps.

H. Transfer switch shall be rated to withstand in RMS symmetrical amperes not less than the available symmetrical RMS amperes when protected by the circuit protective device on the line side of the transfer switch. Withstand rating of switch shall be based on switch contacts not welding under fault conditions. Provide switch with current limiting fuses to increase current withstand rating when switch is not rated for fault duty.

I. The control panel for each automatic transfer switch shall contain the following accessories:

1. Adjustable 0.5 to 6 second time delay on starting of EPS to override momentary power dips and interruptions of the normal services. Time delay shall be factory set at 1 second.

2. Time delay on transfer to emergency adjustable from 0 to 60 seconds, factory set at 0 seconds.

3. Test switch on enclosure door to simulate failure of the normal power source. ATS shall transfer load to the EPS.

4. Push button to bypass time delay on re-transfer to normal.

5. Close differential voltage sensing shall be provided on all phases of the normal power supply. The pickup voltage shall be adjustable from 85% to 100% of nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and re-transfer to normal shall occur when normal source restores to 95% of nominal.

6. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.

7. A time delay on re-transfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 25 minutes and factory set at 15 minutes.

8. An unloaded running time delay for emergency generator cool-down, factory set at 5 minutes.

9. Pilot light for indicating switch in normal position (includes fuses and auxiliary contact).

10. Pilot light for indicating switch in emergency position (includes fuses and auxiliary contact).

11. An exerciser for exercising standby power plant on a weekly basis shall be provided in the transfer switch. Exerciser shall be set to exercise standby plant for one half hour per week under load. Time of plant exercise shall be set in field. Exerciser timer shall have reserve power back-up, either by battery or spring-wound clock, to ride through power outages to the switch.

12. Provide adjustable timed intermediate position in both directions.

13. Auxiliary contact (gold plated) which closes when normal source fails. (Closed after override delay of 0.5 to 6 seconds).

14. Auxiliary contact (gold plated) which opens when normal source fails. (Opens after override delay of 0.5 to 6 seconds).

15. Auxiliary contacts on same shaft as main contacts (closed on normal).

16. Auxiliary contacts on same shaft as main contacts (closed on emergency).

17. Provide pre-transfer and post-transfer contacts for connection to in-plant SCADA system.

J. Bypass Isolation Switch

1. The bypass isolation switch(es) shall have the same specification requirements as the automatic transfer switch portion of this specification except as described below:

   a. The automatic transfer and bypass-isolation switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch. Bypass of the load to either the normal or emergency power source with complete isolation of the ATS shall be possible regardless of the status of the ATS. The bypass-isolation switch shall permit proper operation by one person through the movement of a maximum of two handles at a common dead front panel. The entire system shall consist of two elements: The automatic transfer switch and the bypass-isolation switch furnished completely factory interconnected and tested.

   b. The operating speed of the bypass switch contacts shall be the same as the automatic transfer switch and independent of the speed of operation of the bypass handle.

c. The automatic transfer and bypass-isolation switch shall be the product of one manufacturer and be completely factory interconnected and tested so that only the service and load connections to the bypass-isolation switch are required for field installation. All interconnections between the transfer switch, bypass switch and isolation switch shall be by silver-plated copper bus bar. A visual position indicator shall be provided to indicate bypass-isolation switch positions, and availability of normal and emergency sources. A prominent and detailed instruction plate shall be furnished for convenient operation.

d. The automatic transfer and bypass-isolation switch shall provide manual bypass of the load and isolation of all service and load terminals of the automatic transfer switch to permit periodic testing, maintenance, and service of the automatic transfer switch.

e. The bypass-isolation switch shall be capable of bypassing the load to either source. Provisions shall be made to assure continuity of auxiliary circuits necessary for the proper operation of the system.

f. The isolation handle shall provide for automatic operation, testing, or removal of the automatic transfer switch. The Test position shall permit electrical testing of the automatic transfer switch without disturbing the load. The open position shall completely isolate the transfer switch from both lines and load without actual removal of the line or load conductors, and allow its removal for inspection, adjustment and maintenance. The transfer switch shall be arranged for drawout operation to facilitate its removal. Also, while in the Test or Open positions, the bypass switch shall function as a manual transfer switch to allow load transfer to either source of power regardless of the position or condition of the transfer switch, including the condition when the automatic transfer switch is removed, and without reconnecting the load terminals of the automatic transfer switch.

2.03 FUEL SUPPLY

A. A double wall fuel storage tank with sufficient fuel capacity to allow the EPS to operate continuously at full rated load for 24 hours (1000 gal. min) shall be located in the skids below the generator set, and shall be complete with all piping and fittings connected. No galvanized material shall be used in the tank or fueling system. The tanks shall be vented to atmosphere. A fuel level gauge shall be located as indicated on the drawings. The system shall be supplied to deliver an adequate amount of fuel to the engine from the storage tank. Pipe sizes shall be no smaller than the minimum recommended by the engine manufacturer to avoid fuel flow restriction. The engine supply and return line shall be equipped with a length of flexible fuel lines, unions, and gate valves. No copper lines are acceptable.

B. Provide a set of normally open contacts in fuel level indicating “LOW FUEL” in fuel tank. Interconnect with remote low fuel alarm specified earlier in this section.

C. Provide leak detection monitoring system with a set of normally open contacts in secondary compartment of double wall tank space to indicate presence of fuel.

D. Provide audible/visual alarm so that if tank is above 90% full, alarm sounds. Provide silence switch and engraved sign reading “DISCONTINUE FILLING IF ALARM SOUNDS.”

PART 3 - EXECUTION

3.01 EPS INSTALLATION

A. The plant shall be anchored to a concrete base whose overall dimensions shall exceed the outside dimensions of the plant base by 12” in each direction. Base depth shall be 12”.

1. Concrete base shall be isolated from adjacent concrete paving.

2. Concrete base shall be extended to support maintenance platform.

B. The plant shall be on a welded steel base with vibration isolators. Isolators designed specifically for this application, mounted on rubber plates to block high frequency vibrations shall be provided. Isolators shall be designed for the seismic zone requirements in the area where the generator is installed.

C. Provide a laminated sign at the building service entrance equipment indicating type and location of on-site emergency power sources.

D. For exterior installations, the EPS shall be provided in outdoor, weatherproof housing with removable panels for access to equipment. Color shall be factory standard “sandstone”. The starting batteries shall be rack mounted within the housing. Provide manufacturer’s standard maintenance switched lighting system within housing. Enclosure shall be aluminum rated for 150 mph winds.

E. Provide non-sound attenuating enclosure.

F. Extend 120 volt and/or 208 volt emergency power circuits for fuel pump and cold weather starting aids from the generator mounted panel board.

G. Provide service lights within weatherproof housing plus 2 emergency battery packs with 2 lights per generator.

H. Provide a single phase 120/208 volt panel inside generator enclosure and prewire all auxiliary loads to the panel.

3.02 TRANSFER SWITCH INSTALLATION

A. Locate transfer switch(es) to provide working clearance and full accessibility as required by the National Electrical Code.

B. Lace and group conductors installed in transfer switch with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug. Conductors shall be installed such that no stresses are transferred to terminal lugs.

C. Mounting and Support

1. Mounting

a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. Transfer switches 400 amps and larger shall be secured by a minimum of eight (8) devices. A 1.5 inch minimum diameter round washer shall be used between head or screw or bolt and enclosure.

b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.

c. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to transfer switch and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.

d. Conductors not terminating in transfer switch shall not extend through or enter transfer switch enclosure.

e. Install push-in knock-out closure plugs in any unused knock-out openings.

f. Free standing transfer switch(es) shall be installed on a four inch high concrete pad, with horizontal base dimension exceeding base dimension of switch by three inches.

g. Cleaning and Adjustment

1) After completion, clean the interior and exterior of dirt, paint and construction debris.

2) Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 TESTING

A. Submit verification letter to engineer indicating successful completion of sequence of operations testing and certification that all functions are operational. Letter to request load testing approval and schedule of proposed test. Prior to load test, written approval must be provided by engineer. Representatives of the generator shall be present. The local authority having jurisdiction shall be given advance notification of the time of the final test in order that he may witness the tests.

B. A failure of any test or any component during a test will require a complete retest program at no additional cost to the Owner.

C. Provide all lubricants, and other consumables for testing. Contractor to provide 1,000 gallons of fuel per generator.

D. An on-site acceptance test shall be conducted as a final approval test for all Emergency Power Supply Systems.

1. The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.

2. Test Results. The EPSS shall perform within the limits specified in the standard NFPA-110, level I.

3. The on-site installation test shall be conducted as required by the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

3.04 O&M MANUALS

A. At least three sets of an instruction manual(s) for all major components of the EPS shall be supplied by the Manufacturer(s) of the EPS and shall contain:

1. A detailed explanation of the operation of the system.

2. Instruction for routine maintenance.

3. Detailed instructions for repair of the EPS and other major components of the EPS.

4. Pictorial parts list and part numbers.

5. Pictorial and schematic electrical drawings of wiring systems, including operation and safety devices, control panels, instrumentation and annunciators.

3.05 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

END OF SECTION

SECTION 16400
SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.01 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

1.02 RELATED SECTIONS

1.03 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis

4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings

5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems

6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures

3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis

4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace submittals for review/approval

D. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.04 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:

1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations

2. Descriptions, purpose, basis, and scope of the study

3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings

4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings

5. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout

6. Incident energy and flash protection boundary calculations

7. Comments and recommendations for system improvements, where needed

8. Executive Summary including source of information and assumptions made

1.05 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCT

2.01 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.02 DATA COLLECTION

A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.

B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.

C. Provide the following:

1. Calculation methods and assumptions

2. Selected base per unit quantities

3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted

4. Source impedance data, including electric utility system and motor fault contribution characteristics

5. Typical calculations

6. Tabulations of calculated quantities

7. Results, conclusions, and recommendations

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility’s supply termination point

2. Incoming switchgear

3. Unit substation primary and secondary terminals

4. Low voltage switchgear

5. Motor control centers

6. Standby generators and automatic transfer switches

7. Branch circuit panelboards

8. Other significant locations throughout the system

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings

2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses

3. Adequacy of transformer windings to withstand short-circuit stresses

4. Cable and busway sizes for ability to withstand short-circuit heating

5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.04 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable:

1. Electric utility's protective device

2. Medium voltage equipment relays

3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands

4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands

5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

6. Conductor damage curves

7. Ground fault protective devices, as applicable

8. Pertinent motor starting characteristics and motor damage points

9. Pertinent generator short-circuit decrement curve and generator damage point

10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.05 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

2.06 REPORT SECTIONS

A. Input Data:

1. Utility three-phase and line-to-ground available contribution with associated X/R ratios

2. Short-circuit reactance of rotating machines with associated X/R ratios

3. Cable type, construction, size, # per phase, length, impedance, and conduit type

4. Bus duct type, size, length, and impedance

5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio

6. Reactor inductance and continuous ampere rating

7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:

1. Source fault impedance and generator contributions

2. X to R ratios

3. Asymmetry factors

4. Motor contributions

5. Short circuit kVA

6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:

a. Current transformer ratio.

b. Current setting.

c. Time setting.

d. Instantaneous setting.

e. Specialty non-overcurrent device settings.

f. Recommendations on improved relaying systems, if applicable.

2. Circuit Breakers:

a. Adjustable pickups and time delays (long time, short time, ground).

b. Adjustable time-current characteristic.

c. Adjustable instantaneous pickup.

d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations.

1. Arcing fault magnitude

2. Device clearing time

3. Duration of arc

4. Arc flash boundary

5. Working distance

6. Incident energy

7. Hazard Risk Category

8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.01 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

E. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.02 ARC FLASH WARNING LABELS

A. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, “WARNING, ARC FLASH HAZARD”, and shall include the following information:

1. Location designation

2. Nominal voltage

3. Flash protection boundary

4. Hazard risk category

5. Incident energy

6. Working distance

7. Engineering report number, revision number and issue date

C. Labels shall be machine printed, with no field markings

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided

2. For each motor control center, one arc flash label shall be provided

3. For each low voltage switchboard, one arc flash label shall be provided

4. For each switchgear, one flash label shall be provided

E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.03 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E,

Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals.

END OF SECTION

SECTION 16426
SWITCHBOARDS – FRONT ACCESSIBLE GROUP MOUNTED FEEDER DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the Specifications consists of the installation of all switchboards designated on the drawings to have group mounted feeder devices with front access only construction for use on systems 600 volts and below. All materials and devices which are an integral part of the switchboard shall be provided under this section of the specifications.

B. Definition: Switchboards are floor mounted assemblies of one or more enclosed vertical section containing circuit breakers, switches, meters, fuses, and terminals essential to operation of electrical equipment. A dead front switchboard has no exposed live parts on front.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. National Electrical Manufacturers Association (NEMA) Standards:

a. PB-2: Dead Front Distribution Switchboards

b. PB-2.1: General Instruction for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards rated 600 volts or less.

c. SG-3: Low Voltage Power Circuit Breakers.

2. Underwriters Laboratories, Inc. (UL):

a. UL-489: Molded Case Circuit Breakers and Circuit Breaker Enclosures

b. UL-891: Deadfront Electrical Switchboards

c. UL-977: Fused Power Circuit Devices

3. Institute of Electrical and Electronics Engineers (IEEE):

a. STD-241: IEEE Recommended Practices for Electric Power Systems in Commercial Buildings

4. National Fire Protection Association (NFPA):

a. NFPA-70: The National Electrical Code

5. American National Standards Institute (ANSI):

a. C37.13: Low-Voltage AC Power Circuit Breakers used in Enclosures

b. C37.16: Related Requirements and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Protectors, Preferred Ratings

B. Equipment Dimensions

1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where switchboards of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

C. Coordination

1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Product Data: Switchboards including, but not limited to, voltages, number of phases, frequencies, and short-circuit and continuous current ratings. Provide application data for main and branch circuit-breakers, sections, main buses, and basic insulation levels.

C. Shop Drawings: Layout drawings of switchboards showing accurately scaled basic equipment sections including auxiliary compartments, section components, and combination sections.

D. Wiring Diagrams: For switchboards showing connections to electrical power feeders and distribution branches. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

E. Closeout Submittals: As follows:

1. Record Drawings: Include in each set:

a. Complete set of switchboard manufacturers' product data and shop drawings indicating all post bid revisions and field changes.

b. Schedule of each overcurrent protection device indicating unit ampere rating and rating.

c. Copy of the ground-fault system performance test as required by Article 230-95(c) of the NEC.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver switchboards and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for switchboards and components which protect equipment from damage. Install gravity measuring meters in containers which indicate whether container has been bumped or dropped. Return G-meters to manufacturer for re-use upon delivery of switchboards. Inspect equipment to ensure that no damage has occurred during shipment.

B. Store switchboard equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle switchboard equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.06 SEQUENCING AND SCHEDULING

A. Schedule delivery of switchboard equipment which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.

B. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate with other electrical work including raceways, electrical boxes and fittings, and cabling/wiring work, as necessary to interface installation of switchboards with other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Eaton

2. General Electric

3. Square D

4. Siemens

2.02 GENERAL

A. AC Dead-Front Distribution Switchboards: Provide factory-assembled, dead-front, metal-enclosed, self-supporting secondary power switchboards, of types, sizes, electrical ratings and characteristics indicated; consisting of vertical panel units, and containing circuit-breakers of quantities, ratings and types indicated. Provide copper main bus and connections to circuit-breaker branches of sufficient capacity to limit rated continuous current operating temperature rise of no greater than 65°C above average ambient temperature of 25°C; with main bus and tap connections silver-surfaced and bolted tightly according to manufacturer's torquing requirements for maximum conductivity. Brace bus for short-circuit stresses up to maximum interrupting capacity. Provide accessibility of line and load terminations from front of switchboard. Equip units with built-in lifting eyes and yokes; and provide vertical individual panel units, suitable for bolting together at project site. Construct switchboard units for the following environment:

1. Installation: Indoors, NEMA Type 1.

B. Provide accessory and instrumentation small wiring, necessary fuse blocks and terminal blocks within the switchboard. Control components, such as control transformers, fuse blocks, relays, etc., shall be suitably marked for identification where mounted on the switchboard corresponding to appropriate designations on manufacturer's wiring diagrams. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.03 BUSSING

A. All bus bars shall be silver-plated copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to 65°C rise based on UL tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having an available fault current as shown on the drawings. Provide full capacity neutral where a neutral is indicated on the drawings.

B. A ground bus rated a minimum of 25% of main bus ampacity shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. An incoming ground lug shall be furnished. Other ground lugs for feeder circuits shall also be supplied as shown in the schedules on the drawings.

C. All hardware used on conductors shall be high-tensile strength and plated. All terminals shall be of the anti-turn solderless type suitable for CU or A1 cable of sizes indicated for 75°C cable.

2.04 CONSTRUCTION

A. Switchboards shown mounted against a wall shall be front accessible. All sections of the switchboard shall be 20" deep except service sections containing large ampacity main disconnects which may be deeper as required. All sections of the switchboard shall align so that the back of the complete structure may be placed flush against a wall.

B. Construction shall allow maintenance of incoming line terminations, main device connections and all main bus bolted connections to be performed without rear access. The feeder or branch devices shall be removable from the front and shall be panel mounted with the necessary device line and load connections front accessible. Provide lugs on all devices for cable sizes shown on drawings.

2.05 OVERCURRENT DEVICES - GENERAL

A. Group mounted feeder protective devices shall be molded case breaker type with frame and trip rating as shown on the drawings and have additional characteristics as specified.

B. Devices shall be manually operated (MO).

2.06 MOLDED CASE BREAKERS

A. Protective devices as shown shall be molded case circuit breakers providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics, and where applicable, be current limiting.

1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.
2. Circuit breaker interrupting capacities shall be as indicated on the drawings or as specified hereinafter. Where applicable, circuit breakers shall be listed for series application.

B. Breakers 150 ampere and below shall be thermal-magnetic trip with inverse time current characteristics. Breakers with 250 and 400 ampere frame shall be solid-state trip, as applicable.

C. Breakers with 600 amperes frame and above shall be solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings. Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

1. Trip units shall have adjustable short time setting with a fixed instantaneous override for circuit protection.

2. Breakers shall have built-in test points for testing long delay, instantaneous and ground fault functions of the breaker by means of a 120 volt operated test kit. Provide one test kit capable of testing all breakers 600 ampere and above.

3. Where indicated on the drawings, provide built-in ground fault protection with adjustable pick-up rating not exceeding 1200 amperes; ground fault time delay shall be adjustable 0.1 to 0.5 seconds. Provide neutral ground fault current transformer for four wire systems.

2.07 NAMEPLATES

A. Engraved nameplates shall be furnished for all main and feeder circuits including control fuses and also for all indicating lights and instruments. Nameplates shall give item designation and circuit number as well as frame size and appropriate trip rating. Furnish Master nameplate giving switchboard designation, voltage ampere rating, short circuit rating, manufacturer's name, general order number and item number. Refer to ELECTRICAL IDENTIFICATION section of this specification.

2.08 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 and use the manufacturer's standard process.

2.09 CONTROL POWER TRANSFORMERS

A. Control power transformers with primary and secondary protection shall be provided as indicated on the drawings or where required to operate ground fault systems, adequately sized for required burdens.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine areas and conditions under which switchboards and components are to be installed, and notify General Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until

unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION OF SWITCHBOARDS:

A. Install switchboards as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of NEC, NEMA's Stds Pub/No. PB 2.1, and NECA's "Standard of Installation".

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486 A and B, and the National Electrical Code.

3.03 FIELD QUALITY CONTROL

A. Refer to ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

3.04 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.05 GROUNDING

A. Provide equipment grounding connections for switchboards as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.06 FIELD QUALITY CONTROL

A. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 16450
SECONDARY GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of furnishing, installation and connections of the building secondary grounding systems. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be a 3 phase, 4 wire grounded wye system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:

No. 44: Rubber - Insulated Wire and Cables

No. 83: Thermoplastic - Insulated Wires

No. 467: Electrical Grounding and Bonding Equipment

No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables

No. 486: Wire Connectors and Soldering Lugs

2. National Electrical Manufacturer's Standards (NEMA):

a. WC-5: Thermoplastic Insulated Wire and Cable

b. WC-7: Cross-Linked-Thermosetting Polyethylene Insulated Wire and Cable

3. National Fire Protection Association Publication (NFPA):

a. No. 70: National Electrical Code (NEC)

B. Acceptable Manufacturers. Products produced by the following manufacturer which conform to this specification are acceptable.

1. Hydraulically applied conductor terminations:

a. Square D
b. Burndy
c. Ilsco
d. Scotch (3M)
e. Thomas and Betts (T & B)
f. Anderson
g. Or equal

2. Mechanically applied (crimp) conductor terminations:

a. Scotch (3M)
b. Ideal
c. Thomas and Betts (T & B)
d. Burndy
e. or equal

3. Exothermic connections:

a. Cadweld
b. Or equal

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications. All materials shall be new.

B. All materials shall be UL listed and bear a UL label.

C. Refer to the specific specification section for the description and requirements of materials mentioned herein for installation.

2.02 GROUNDING CONDUCTORS

A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the drawings.

B. Equipment grounding conductors shall be green insulated type THHN, THWN, or XHHN conductors sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.

C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.03 TRANSFORMERS, MOTOR CONTROLLERS, AND DISCONNECT SWITCHES

A. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.04 DEVICES

A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.05 GROUND RODS

A. Ground rods shall be 3/4" x 10'-0" copper clad steel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.

B. Service entrance and separately derived electrical systems, grounding electrode system.

1. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in galvanized rigid steel. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.

2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity. Install a bonding jumper of the same size as the grounding conductor around the water meter.

3. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.

a. Cold water piping system

b. Ground rod system

c. Structural steel metal building frame

d. Main rebar in a foundation footing, for a concrete structure

4. Ground the neutral of all dry type transformers to building steel which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. Make connection to building steel with an exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.

5. Ground the neutral and frame of the emergency generator to the ground rod system, which shall serve as the grounding electrode for the separately derived system.

6. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.

7. Where more than one service serves a building or interconnected buildings, connect each service equipment ground bus together with a #4/0 copper conductor in PVC conduit.

8. Bonding shall be in accordance with the National Electrical Code.

9. Install ground rods where indicated on the drawings with the top of the ground rods 12" below finished grade.

C. Equipment Grounding Conductor

1. Grounding conductors for branch circuits are not shown on the drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables. Grounding conductors shall be the same AWG size as branch circuit conductors.

2. Grounding conductors for feeders are typically indicated on the drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.

3. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.

4. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other purpose. Where grounding

conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tool.

5. Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with crimping tool.

6. Equipment grounding conductors shall terminate on panelboard, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus. Provide a single terminals lug for each conductor. Conductor shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

D. Other Grounding Requirements

1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the "point of grounding" of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as "point of grounding". Terminate conductor by stapling to backboard.

2. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.

3. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by exothermic weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100’ on centers across expansion joints.

3.02 TESTING

A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within forty-eight hours of rainfall. Results of ground resistance readings shall be forwarded, in writing, immediately to the Engineer.

END OF SECTION

SECTION 16460
TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of the furnishing, connection, and installation of dry type transformers.

B. Definition: Dry type transformers, as described herein, applies to those with primary and secondary voltage connections of 600 volts and less. Autotransformers are not acceptable, except where indicated for buck boost or zig-zag connections.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.

1. Underwriter's Laboratories, Inc. (UL) Publications:

No. 506 Transformers (1000 KVA, 3 phase and below; 167 KVA, 1 phase and below)

2. National Fire Protection Association (NFPA):

No. 70 National Electrical Code (NEC)

3. National Electrical Manufacturers Association (NEMA):

No. ST-20 Dry-type transformers for general applications

4. American National Standards Institute (ANSI):

a. No. C57.12.80 Terminology for Power and Distribution Transformers

b. No. C57.12.90 Guide for Short Circuit Testing of Distribution and Power Transformers

c. No. C57.94 Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.

1. Eaton

2. General Electric

3. Square D

4. Siemens

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure transformer access and clearance minimums are provided, and adequate ventilation is permitted.

1.04 SUBMITTALS

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Manufacturers Product Data:

1. Submit material specifications and installation data for products specified under PART 2 - PRODUCTS. Product data shall indicate sound and temperature rating, overload capacity and efficiency at 25%, 50% and 100% load, available taps, voltage, impedance, nameplate data, wiring diagrams, physical dimensions, and net weight. Product data shall also contain certification that transformers are constructed and tested in accordance with standards specified herein.

C. Record Drawings. Include in each set:

1. A complete set of manufacturers product data indicating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein and indicated on the drawings.

B. All transformers shall be UL listed and bear a UL label.

C. Transformers shall be self-cooled, rated for continuous operation at rated KVA, 24 hours per day, 365 days per year with normal life expectancy (IEEE Standard No. 65). KVA ratings shall be as indicated on the drawings.

2.02 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Insulation System

1. Single phase 25 - 167 KVA and three phase 30 - 1500 KVA: Transformers shall be rated for average temperature rise by resistance of 220°C in 40°C. maximum ambient, 30°C average ambient. Transformer insulation system shall be UL rated as 220°C. system.

2. Three phase 3 - 15 KVA: Transformers shall be rated for average temperature rise by resistance of 115°C. Insulation system shall be 180°C.

3. Single phase up through 250 VA: Transformers shall be rated for 55°C. rise by resistance. Insulation system shall be 105°C.

4. Single phase 500 - 3000 VA: Transformers shall be rated for 115°C. temperature rise by resistance. Insulation system shall be 180°C

B. Sound rating shall not exceed NEMA and ANSI standards for KVA rating. Internal vibration dampening shall be provided as a standard feature of all transformers.

C. Single phase transformers rated up to 15 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All other single phase and all three phase transformers shall be provided with six 2-1/2% full capacity taps, two above and four below normal voltage unless only four 2-1/2% taps, two above and two below normal voltage, are standard.

D. Construction and Enclosures

1. Transformers 30 - 1500 KVA: Transformer enclosures shall be open, ventilated, drip-proof with removable front and rear cover panels. Transformers shall be suitable for floor mounting, unless wall mounting is indicated on the drawings.

2. Transformers up through 25 KVA: Transformers shall be totally enclosed, non-ventilated with a resin encapsulated core and coil and drip-proof housing. Removable panel section shall permit access to wiring compartment.

E. Dry type transformers shall provide 3 phase 4 wire 208Y/120 volt service to designated panelboards or other equipment. Primary rating shall be 480 volts.

F. Nominal transformer impedance shall be 4.5 percent minimum, unless otherwise indicated on the drawings.

G. Dry type transformer K-factors shall be as indicated on the drawings and as outlined in ANSI C57.110 "Recommended Practice for Establishing Transformer Capability when Supplying Nonsinusoidal Load Currents."

H. Core assemblies and the center ground connection point of the coil secondaries shall be grounded to their enclosures by adequate, flexible ground straps. Provide grounding lug at the strap to enclosure bonding location for connection of three conductors; the primary and secondary equipment grounding conductors and the grounding electrode conductor.

I. Provide weather shield on transformers indicated on drawings and for all exterior installations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Dry transformers larger than 15 KVA shall be floor mounted, unless wall or suspension mounting is indicated on the drawings. Transformers 15 KVA and smaller shall be wall mounted. Installation shall provide not less than twelve inch clearance from walls or equipment. Floor mounted transformers shall be mounted on neoprene, waffle type vibration pads 5/8" thick. Where transformers are indicated on the drawings, or specified herein to be mounted on suspended channels of angles or wall mounted, transformers shall be bolted to structure with 5/8" thick vibration pad between transformer base and structural surface. Loosen shipping bolts to free up internal vibration mounts on core and coil assembly.

B. Primary and secondary connections to dry type transformers shall be made with flexible conduit.

C. The secondary windings of each dry type transformer shall be grounded in accordance with the National Electrical Code requirements for separately derived electrical systems. Extend a grounding electrode conductor from the transformer grounding lug to the nearest building structural steel or main column rebar. Connect the primary and secondary feeder equipment grounding conductors to the grounding lug. Refer to the secondary grounding section of these specifications for additional requirements.

D. Install secondary overcurrent protective device within 10 feet of conductor length. Where none is indicated on plans, provide enclosed circuit breaker within 10 feet rated at 125 percent of the transformer full load ampacity but not greater than the secondary conductor ampacity.

E. Do not install equipment over transformer, unless indicated on the drawings.

F. Locate transformers to provide working clearance and full accessibility as required by the National Electrical Code.

3.02 CLEANING AND ADJUSTMENT

A. Prior to final inspection, under maximum available load, measure secondary voltage and adjust tap setting to deliver nominal rated voltage within the percentage limits of one tap setting. Record the voltages of each transformer and submit in accordance with the requirements specified in the basic electrical requirements section.

B. After completion, clean the interior and exterior of dirt, paint, and construction debris.

C. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

END OF SECTION

SECTION 16470
PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of the furnishing, installation and connection of lighting and appliance panelboards and distribution type panelboards.

B. Panelboards designated as HDA, HDB, DA, DB, etc., or indicated on the drawings shall be distribution type panelboards. Those designated as HA, HB, A, B, etc., are lighting and appliance type panelboards.

C. Definitions: The term panelboard, as used in this specification or on the drawings, shall mean the complete assembly including the enclosure, bus work, trim hardware and circuit breaker or fused devices. The words panel and panelboard are used synonymously in these contract documents.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.

1. Underwriters' Laboratories, Inc. (UL) Publications:

No. 50: Cabinets and Boxes, Electrical

No. 67: Panelboards

No. 489: Molded Case Circuit Breakers and Circuit Breaker Enclosure

2. National Electrical Manufacturer's Association (NEMA) Publications:

No. PB-1: Panelboards
No. AB-3: Molded Case Circuit Breakers

3. National Fire Protection Association (NFPA):

No. 70: National Electrical Code (NEC)

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.

1. General Electric

2. Eaton

3. Square D

4. Siemens

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure panel access and insure that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

B. Manufacturers Product Data:

1. Submit material specifications and installation data for products specified under Part 2 - Products to include:

a. Circuit breakers

b. Panelboards

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.

1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.

2. Include front elevation bussing diagram indicating each bussing circuit breaker position.

3. Provide a schedule indicating circuit breaker type, trip and size, poles, frame type, and interrupting capacity.

4. Nameplate identification designation schedule.

D. Record Drawings. Include in each set:

1. A complete set of panelboard manufacturers product data and shop drawings indicating all post bid revisions and field changes.

2. A copy of each panelboard directory incorporating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All panels and circuit breakers shall be UL listed and bear a UL label.

C. Panels shall be of the dead front safety type.

D. Provide panels complete with factory assembled circuit breakers connected to the bus bars in the positions shown on the panel schedules or bus diagrams as indicated on the drawings.

E. Number all panelboard circuits in the following sequence:

1. Circuits No. 1 and 2, Phase A; Circuits No. 3 and 4, Phase B; Circuits No. 5 and 6, Phase C. Connect two pole breakers to phase indicated on the drawings.

2.02 BUSSING AND INTERIORS

A. All bus bars shall be copper. Main lugs and main breakers shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain an equipment grounding bus. Each lighting and appliance panelboard shall contain a full size insulated neutral bus. Where a distribution type panelboard is indicated on the drawings to have a neutral bus, the bus shall be insulated and full size, unless otherwise indicated on the drawings.

B. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

C. The ground bus shall be factory brazed, riveted or installed on studs welded to the panel enclosure or panel frame. The ground bus shall not be attached to the panel interior.

D. Where designated on panel schedule as "space", include all necessary bussing, device support and connections. Provide blank cover for each space.

E. Where specified or indicated on the drawings, provide sub-feed lugs adjacent to the mains and increase box heights to provide additional cable bending and termination space. Lugs to be the same size and capacity as mains and rated for aluminum or copper conductor terminations.

2.03 ENCLOSURES

A. Panelboard width shall not be less than 20", nor more than 22" unless specific width is indicated on the drawings. Panelboard depth shall not exceed 5-3/4".

B. Distribution panelboard width shall not be less than 31" and the depth shall not exceed 14".

C. Review panelboard schedules and system one line diagram and provide panelboard gutters and bending space at terminals to conform to the National Electrical Code.

D. Provide concealed captive clamping devices, concealed hinges and lock for all flush mounted panels. Key all panels throughout project alike.

E. All surface mounted panels shall be provided with door-in-door hinged cover trims. Trims shall be secured by piano hinges to enclosure and secured closed by two trim clamps.

F. Where two section panels are required, both sections shall have fully rated bus and separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims and card holder with each section.

G. Provide a directory card, metal holder, and transparent cover permanently mounted on inside of doors.

H. Where indicated on the drawings or required for the environmental conditions, provide a NEMA 4X stainless steel enclosure. Mount a thermostatically controlled 120V electric space heater in the enclosure. Connect to a 480V to 120V control power transformer with fused primary and secondary windings. Drill and tap bus and connect primary leads.

2.04 CIRCUIT BREAKERS

A. Interrupting rating of all circuit breakers in panelboards operating on 208Y/120 volt system shall have UL rating of not less than 10,000 RMS symmetrical amps at system voltage. Panelboards for use on 480Y/277 volt system shall contain circuit breakers with UL interrupting rating of not less than 14,000 RMS symmetrical amps at system voltage. Provide circuit breakers with higher interrupting capacity when indicated on the drawings.

B. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the drawings or specified herein.

C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.

D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panelboards shall be bolted to the bus except, Square D I-line style plug in devices are acceptable.

E. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less.

Magnetic trip shall be adjustable for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.

F. Provide the following special devices and accessories when indicated on the drawings, specified herein, or required by the NEC.

a. Ground fault interrupting circuit breaker (GFI).

b. Provide handle lock-off device to prevent manually turning off device without removal. Install on all circuit breakers indicated on the panel schedule.

c. Provide shunt trip device for electrically tripping circuit breakers indicated on the drawings. Shunt trip to be for operation on a 120V or 277V source and have integral coil clearing contacts to de-energize coil after operation. Connect shunt trip to circuit indicated on the drawings.

2.05 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount panelboards with top circuit not more than 6'-6" above finished floor.

B. Lace and group conductors installed in panels with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug.

C. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the specifications and do not exceed.

D. Mounting and Support

1. Mounting

a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.

b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.

c. Attach enclosure directly to masonry, concrete, or wood surfaces.

d. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure or sheet rock walls.

E. Conductors not terminating in panelboard shall not extend through or enter panel enclosure.

F. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.

G. Provide in each panelboard with a typewritten circuit directory mounted under clear plastic in a metal directory frame on interior of panel door. Directory shall reflect any field changes or additions.

H. Install push-in knock-out closure plugs in any unused knock-out openings.

I. Identification

1. Panelboards and individually mounted circuit breakers shall be identified.

2. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint, and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

C. Adjust and align panelboard interior and trim in accordance with manufacturers recommendations, and to eliminate gaps between the two.

3.03 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

END OF SECTION

SECTION 16481
MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the Specifications consists of the installation of all Motor Control Centers for use on systems 600 volts and below. All materials and devices which are an integral part of the Motor Control Center shall be provided under this section of the specifications.

B. Definition: Motor Control Centers are floor mounted assemblies of one or more enclosed vertical sections having a common horizontal power bus and primarily containing combination Motor Control Units. Units are mounted one above the other in the vertical sections, with power supplied to the individual units by vertical power busses. The words motor control units, starters, and motor controllers are used synonymously in these contract documents.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this Specification by reference.

1. National Electrical Manufacturers Association (NEMA) Standards:

a. ICS-1: General Standards for Industrial Control and Systems

b. ICS-2: Industrial Control Devices, Controllers and Assemblies

c. ICS-3: Industrial Systems

d. ICS-4: Terminal Blocks for Industrial Control Equipment and Systems

e. ICS-6: Enclosures for Industrial Controls and Systems

2. Underwriters Laboratories, Inc. (UL) Publications:

a. UL 198.4: Class R Fuses

b. UL 508: Industrial Control Equipment

c. UL 845: Standard for Motor Control Centers

3. National Fire Protection Association (NFPA)

a. NFPA 70: National Electrical Code

4. American National Standards Institute (ANSI):

a. C97.1: Low Voltage Cartridge Fuses, 600 Volts or Less

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.

1. Motor control centers and controllers:

a. Square D

b. General Electric

c. Eaton

d. Siemens

2. Fuses:

a. Gould-Shawmut

b. Bussman

c. Littlefuse

C. Equipment Dimensions

1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where motor control centers of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination

1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to basic electrical requirements section for submittal requirements.

B. Manufacturer's Product Data:

1. Submit material specifications and installation data for products specified under Part 2 - Products to include:

    a. Motor controllers

    b. Motor control centers

    c. Fuses

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.

1. Include electrical characteristics and ratings for each motor control center with dimensions, mounting, bus material, voltage, bracing, ampere rating, mains, poles and wire connection, and any accessories.

2. Include bussing diagram indicating each bussing motor control unit, circuit breaker, or fused switch position.

3. Provide a schedule indicating motor control unit type, or trip and size, poles, frame type, fuse size and type, and interrupting capacity.

4. Identification designation schedule.

D. Record Drawings - Include in each set:

1. A complete set of motor control center manufacturers product data and shop drawings indicating all post bid revisions and field changes.

2. A schedule of each motor's actual full load nameplate rating and NEMA design with the selected overload heater catalog number and current range.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish all materials specified herein.

B. Motor control center, motor control units, circuit breakers, and fused devices shall be UL listed and bear the UL label.

C. The type of enclosure shall be in accordance with NEMA standards for Type 1, gasketed construction. All enclosing sheet steel, wireways and unit doors shall be gasketed.

D. The motor control center shall be suitable for operation on a 480 3-phase, 3-wire 60 Hz system.

E. Motor control center wiring shall be NEMA Class I type B.

2.02 STRUCTURE ARRANGEMENT

A. Motor Control Center shall consist of free-standing, standardized vertical sections; each section shall have the following nominal dimensions: 90" H. x 20" W. x 20D. Maximum overall dimensions, not to be exceeded, shall be as indicated on the drawings.

B. Each section shall contain continuous horizontal and vertical wireways. The horizontal wireway shall be located at the top and bottom of the section. Vertical wireways shall be provided adjacent to each unit. All wireways shall have provisions for cable support, shall be isolated from the bus bars and shall be accessible through hinged doors held closed by captive screws.

C. Adequate space for conduit and conductors entering the top or bottom, in accordance with the National Electrical Code, shall be provided without structural interference. Conductors shall be safely accessible without disrupting service.

D. Individual sections shall be assembled to form a totally enclosed deadfront, front accessible motor control center, as indicated on the drawings.

E. Motor control center design shall permit the future installation of matching vertical sections without the need for transition sections.

2.03 BUS ARRANGEMENT

A. Each vertical section shall contain a continuous three-phase bus, rated as shown on the drawings. Vertical busses shall be connected to the main horizontal bus.

B. A continuous, three-phase, main horizontal bus, rated as shown on the drawings, shall be provided for the distribution of power to the vertical busses. The main bus shall be located in the upper part of the structure.

C. All non-current-carrying parts of the control center shall be grounded through the use of a continuous horizontal ground bus connected to vertical ground busses in each section. Ground bus rating shall not be less than 25% of main bus rating. Bus design shall include feature that for any plug-on unit the ground bus stab shall make contact with the ground bus before the power bus contact is made.

D. All busses shall be tin-plated copper, rated for a 50 degrees C. temperature rise above a 40 degrees C ambient. The minimum bus bracing, in RMS - symmetrical-amperes, shall be as shown on the drawings. Busbars shall be isolated and insulated with polyester boards front and back.

E. A front accessible main lug compartment shall be provided for incoming line termination. Lugs shall be suitable for terminating the size and quantity of conductors as indicated. The compartment shall be located in the unit space shown on the drawings and shall have a hinged door held closed by captive screws. Door shall have provisions for a padlock.

2.04 UNIT CONSTRUCTION

A. Combination magnetic starters shall be installed in removable units constructed in basic heights of 12" or multiples thereof. Each unit shall be isolated from others on structure. Connection to vertical bus for NEMA size five across the line starters and smaller shall be made with draw out stab type connection. Each plug-in type unit shall have a provision for positive horizontal and vertical alignment. Provisions shall also be included for positive ground connections through plug-in facilities. Each magnetic starter shall contain a solid state overload relay for each phase, three in all. Each unit shall contain separable control terminal blocks and separable power terminal blocks to permit removal of unit without disturbing control wiring.

B. Magnetic starters shall be the combination type with molded case circuit breakers. UL listed interrupting rating of molded case circuit breakers shall not be less than indicated on the drawings at system voltage.

C. Solid-State Overload Relay

1. Where indicated on the drawings, provide a definite-purpose, microprocessor- based Overload Relay (OLR) in each starter and/or where indicated on the drawings for protection, control and monitoring of the motors. The OLR shall meet UL 1053, CUL and CSA standards

2. The relay shall not require external current transformers for applications up to 150 amperes for motors rated less than 600 Vac. Where larger motors are involved, external current transformers shall be used. The relay shall include terminals for remote trip and remote reset.

3. The OLR shall have the following motor control functions:

   a. Fault relay, Form C, NO/NC contact with a rating code of B300 per UL 508.
   b. Ground fault relay, Form A, NO contact with a rating code of B300 per UL 508.
   c. External remote reset terminal
   d. Trip status indicator

4. The OLR shall be capable of accommodating external current transformers with ranges from 150:5, 300:5, and 600:5 amperes. Provide three (3) current transformers sized per manufacturer's recommendations based on motor full- load amperes and service factor.

5. The OLR shall draw its power from the line-voltage input for the motor. The OLR shall be suitable for either 50 Hz or 60 Hz

6. The OLR shall have selectable trip classes 5-30.

7. The OLR shall be equipped with an operator-interface (OI)/ display interface panel. The OI shall have a seven-segment display for programming, monitoring, and alarming functions.

8. The OLR shall annunciate the following conditions:

   a. Motor Protection consisting of:
      1) Thermal overload
      2) Jam protection
      3) Current unbalance
      4) Current phase loss
      5) Ground fault
      6) Phase reversal
      7) Load protection consisting of:
         a) Under-current
         b) Low power (kW)
         c) High power (kW)

      8) Line Protection consisting of:
         a) Over-voltage
         b) Under-voltage
         c) Voltage unbalance
         d) Voltage phase unbalance

9. The OLR shall have the following monitoring capabilities:

   a. Current—Average and Phase RMS
   b. Voltage—Average and Phase RMS
   c. Power—Motor kW
   d. Power Factor
   e. Frequency
   f. Thermal capacity
   g. Run hours
   h. Ground fault current
   i. Current unbalance %
   j. Voltage unbalance %

10. The OLR shall be equipped with Ethernet/IP Communications from remote monitoring and load shed control from SCADA. Reduced voltage starters shall be combination, closed transition, solid state type. Reduced voltage starters shall be provided with shorting contactors.

D. VARIABLE FREQUENCY DRIVES (VFD)

1. Refer to Spec Section 16500 for VFD requirements.

E. Individual motor controller doors and individual overcurrent device doors shall be interlocked to prevent door from being opened until switch is in "OFF" position. However, a "cheater screw" or other inconspicuous means shall be provided to permit access to energized starter, by authorized personnel. An interlock contact shall be provided within the starter to open control circuit to magnetic starter when device handle is in the open position. A door activated interlock switch is not acceptable.

F. Each controller shall be provided with HOA switch, as indicated on the drawings. Where no device is indicated on the drawings, provide an HOA switch for any motors automatically controlled or an ON-OFF switch for those specified to be manually controlled. Provide each magnetic starter with a "RUN" and an "OVERLOAD" pilot lamp. Control devices shall be of oil tight construction and shall be mounted on a removable panel on the unit door. Identify each control device with a metal tag or plastic laminated label.

G. Solid state overload protection shall be adjustable and manually reset solid state type, settings shall be coordinated in accordance with full load rating of motors actually furnished. Relay switching mechanism shall be single pole, double throw with normally open position connected to operate a door mounted, oil tight blue pilot lamp to indicate starter has tripped on overload. A thermal overload schedule applicable to control centers shall be provided on inside of door of each magnetic starter.

H. Control voltage for magnetic starters shall be 120 volts obtained from a individual control power transformers in each magnetic starter. Each control power transformer shall be fused.

I. Provide contacts in magnetic starters to provide interlocking control sequence of operation specified under other Divisions. Provide one normally open and one normally closed spare auxiliary contact in each starter.

J. Starter sizes are based on design conditions using horsepower ratings of motors indicated on drawings. If motors actually furnished have horsepower ratings other than those indicated, motor starters and feeders shall be adjusted in accordance with the rated horsepower at no additional cost to the Owner.

K. Provide, where indicated, molded case circuit breakers for feeder protection. All circuit breakers shall have UL interrupting rating of not less indicated on the drawings, at system voltage.

L. Two speed magnetic starters shall be for two winding two speed motors. Starters shall be combination type with dual sets of overload relays, hand-off-automatic switch and fast-slow-stop selector switch and "hi-low" pilot lamps. Starters shall contain a time-delay relay, adjustable from 0 to 30 seconds factory set at 20 seconds, which will interrupt power to the motor for the duration of the time settings.

2.05 AUXILIARY EQUIPMENT

A. Identification:

1. The motor control center, each magnetic starter, each feeder protective device, and each auxiliary equipment item shall be provided with an engraved plastic nameplate approximately 1" x 3" permanently attached to the unit exterior door with self-tapping screws. Refer to ELECTRICAL IDENTIFICATION section.

2. Refer to the basic electrical requirements section of these specifications for nameplate requirements.

3. Submit complete schedule with the shop drawings listing all nameplates and information thereon.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install motor control center on 3" high concrete pad, the horizontal dimensions of which shall exceed the base dimensions of the motor control center by 3" on all sides.

B. Control and power circuits shall terminate in respective section in which starter is located.

C. Lace and group conductors installed in motor control center with nylon tie straps. Only one conductor shall be installed under each terminal. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eighth inch from terminal lug.

D. Do not splice conductors in motor control center. Where required, installed junction box adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the wires and cables section of the specifications and do not exceed.

E. Conductors not terminating in motor control center section or unit shall not extend through or enter the section or unit.

F. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

C. Select and install overload heaters based on the full load current of the motor actually installed. All heaters in a starter shall be of the same size.

3.03 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

END OF SECTION

SECTION 16500
VARIABLE FREQUENCY DRIVE UNITS

PART 1 - GENERAL

1.01 THE SUMMARY

A. General

1. The CONTRACTOR shall provide variable frequency drive (VFD) units, complete and operable, as indicated in accordance with the Contract Documents.

2. It is the intent of this Section to require complete, reliable, and fully tested variable frequency drive systems suitable for attended or unattended operation.

B. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to standardize appearance, operation, maintenance, spare parts, and manufacturer's services.

2. This requirement, however, does not relieve the CONTRACTOR of overall responsibility for the WORK.

C. Coordination

1. Equipment provided under this Section shall operate the electric motor driver and the driven equipment as indicated under other equipment specification Sections.

1.02 CONTRACT SUBMITTALS

A. Shop Drawings: Include the following information:

1. Equipment Information

a. Name of drive manufacturer

b. Type and model

c. Assembly drawing and nomenclature

d. Maximum heat dissipation capacity in kw

2. Conduit entrance provisions

3. Circuit breaker type, frames, and settings

4. Information related to relays, timers, pilot devices, control transformer va, and fuse sizes, including catalog cuts

5. Ladder Diagram

   a. Submit the system schematic ladder diagram and interconnection diagrams.

   b. The schematic ladder diagram shall include remote devices.

   c. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic as indicated.

   d. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned to the CONTRACTOR stamped "REJECTED."

6. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this Section

B. The Technical Manual shall include the following documentation:

1. Manufacturer's 2-year warranty

2. Harmonic analysis report

3. Field test report

4. Programming procedure and program settings

C. Spare Parts List

1. Submit information for parts required by this Section plus any other spare parts recommended by the controller manufacturer.

PART 2 - PRODUCTS

2.01 GENERAL

A. The CONTRACTOR shall provide variable frequency drives as indicated on the drawings.

2.02 EQUIPMENT

A. General

1. The power supply shall be an adjustable frequency inverter designed to convert incoming 3-phase, 480-volt, 60-Hertz power to a DC voltage and then to adjustable frequency AC by use of a 3-phase inverter.

2. Inverters shall be sized to match the KVA and inrush characteristics of the motors actually provided.

3. Match the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled.

4. Variable Frequency Drive permitted configuration

    a. "Clean power" 18-Pulse VFD

    b. 6-Pulse VFD with AP Broadland Filters for motors greater than or equal to 50Hp.

    c. Active front end VFD designs with 3 level type active rectification with TDI at drive input terminals is no more than 5%.

    d. VFD with internal DC links reactors.

5. Harmonic Reduction

    a. The VFD shall be provided with line-side harmonic reduction, as required, to insure that the current distortion limts, as defined in table 10.3 of IEEE 519-1992, are met. PCC, defined as the low voltage side of the distribution transformer, is used for purposes of calculation and referred, by the turns ratio of the transformer, to the PCC deinfed by the IEEE Recommended Practices as the Consumer-Utility interface. The tables of limits set forth therein are with reference to the PCC (primary side of the main transformer).

    b. Harmonic solutions shall be designed to withstand up to 2% line imbalances with the maximum Current Distortion not to exceed 11% at 100% load.

    c. Harmonic solutions shall be capable of withstanding up to 2% ambient voltage distortion with the maximum Current Distortion not to exceed 12% at 100% load.

    d. To ascertain the harmonic contribution of the VFD's at the PCC and to show compliance with IEEE 519-1992, harmonic analysis shall be performed and provided in the submittal package. The contractor shall provide the VFD vendor the below listed information for submittal.

        1) kVA rating of the low voltage distribution transformer(s)

        2) X/R Ratio of utility low voltage distribution transformer(s)

        3) Primary voltage

        4) Secondary voltage

5) Secondary %IZ (impedance)

6) Length, size and number of conductors between transformer LV side and distribution panel

7) System Single Line Diagram and electrical equipment list showing transformer and VFD detail

8) Total linear load kW to be connected to the distribution transformer

9) Anticipated maximum demand load (15 minute or 30 minute) on the distribution transformer (IEEE 519)

B. Inverter

1. The inverter shall be of a voltage-source design, producing a pulse-width-modulated type output.

2. Six-step and current-source inverters will not be accepted.

3. Motor Coordination

a. Inverters shall be capable of operating with 460-volt, 3-phase, 60-Hertz, squirrel-cage, high-efficiency, inverter duty, induction motors.

b. Inverters shall be capable of operating motors over the range of 50-100 percent of base speed without derating or requiring any motor modifications.

4. Inverters shall be capable of delivering the nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers.

5. The VFD shall vary both the AC voltage and frequency simultaneously in order to operate the motor at required speeds.

C. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent efficiency at 50 percent speed and load.

D. Power Outage

1. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases.

2. Upon restoration of power and a START signal, the motor shall restart and run at the speed corresponding to the current process input signal.

E. The VFD shall be provided with the following features:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent)

2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.

3. Adjustable acceleration and deceleration

4. Input signal of 4 - 20 ma from process

5. Output speed signal of 4 - 20 ma; signals other than 4 - 20 mA will not be accepted.

6. Upon loss of input signal, the VFD shall operate at a preset speed.

7. A minimum of 2 selectable frequency jump points in order to avoid critical resonance frequency of the driven system.

8. Additional devices and functions as indicated

9. Ethernet communications to transmit VFD data to/from a plant PLC-based control system.

10. Provide hardwired connections to plant control system where shown on the drawings.

F. The VFD shall be provided with, as a minimum, the following protection features:

1. Input line protection with metal oxide varistor (MOV) and RC network

2. Protection against single phasing

3. Instantaneous overcurrent protection

4. Electronic overcurrent protection

5. Ground fault protection

6. Overtemperature protection for electronics

7. Protection against internal faults

8. Ability to start into rotating motor (forward or reverse rotation)

9. Additional protection and control as indicated and as required by the motor and driven equipment

G. The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.

1. Elevation

    a. Elevation to 3300 feet
    b. For elevation greater than 3300 feet, the VFD shall be derated in accordance with the manufacturer's recommendation

2. Ambient Temperature: 0 to 40 degrees C.

3. Humidity: 0 to 95 percent, non-condensing

4. AC Line-Voltage Variation: plus 10 percent to minus 10 percent

5. AC Line-Frequency Variation: plus and minus 2 Hertz

H. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:

1. 2-1/2-percent (minimum) line and load reactors integral to the drive enclosure.

2. Fused 480-to-120-volt control transformer to provide system control power for the logic and pilot lamps.

3. Provide an input circuit breaker.

I. Inverter Signal Circuits

1. The inverter signal circuits shall be isolated from the power circuits and shall be designed to accept an isolated 4-20 mA signal in the automatic mode of operation.

2. The inverter shall follow the setting of a remote or local potentiometer control while in the manual mode.

3. Refer to the Elementary Schematic indicated on the Drawings for speed control and START/STOP methods.

4. Access to set-up and protective adjustments shall be protected by key-lockout.

5. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure, either as discrete devices or as part of a multi-function microprocessor-based keypad access device:

    a. AUTO/HAND selection from a remote logic relay or switch

    b. While in AUTO, the inverter shall operate from the remote 4-20 mA input, where applicable, and while in HAND control shall operate from a local or remote manually operated speed

potentiometer; speed pot ratings shall be coordinated with the supplier of the Local Control Station.

c. Speed indicator calibrated in percent speed

d. Inverter fault trip pilot light and output alarm contacts

e. Trip reset pushbutton

f. RUN and OFF indicating lights

g. Provide other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Elementary Schematics indicated on the Drawings.

J. Properly identified screw type terminal boards shall be provided for interconnection to remote controls and instrumentation

K. Refer to the Elementary Schematics for hardwired VFD control inputs. The electrical design is based on 120VAC. Where the drive is not provided with “wetting” voltage of 120VAC the supplier shall provide interposing relays so that all field wiring remains 120VAC.

2.03 HARMONIC ANALYSIS FOR DRIVES

A. The CONTRACTOR shall perform a harmonic study of the facilities included in this Project.

B. The following assumptions shall be utilized for the harmonic analysis:

1. The distribution system is a "general" system as classified by IEEE 519 under low voltage systems.

2. Assume 95 percent of total plant operating load is motor load and 5 percent is resistive.

3. Assume a 70 percent plant diversity factor (i.e., 70 percent of the total plant load is operating), with motors other than VFDs operating at 90 percent of their nameplate horsepower.

4. Assume all VFDs are operating except as shown in paragraph 2.1.

5. Report

a. Results of the harmonic analysis shall be submitted prior to VFD shipment.

b. Excessive harmonic distortion shall be specifically denoted.

c. Corrective measures shall be submitted for action by the ENGINEER.

2.04 SPARE PARTS

A. Furnish the spare parts listed below, suitably packaged and labeled with the corresponding equipment number.

B. Modified Parts

1. At any time prior to Substantial Completion, the CONTRACTOR shall notify the ENGINEER in writing about any manufacturer's modification of spare part numbers, interchangeabilities, or model changes.

2. If the ENGINEER determines that the modified parts no longer apply to the equipment provided, the CONTRACTOR shall furnish other applicable parts as part of the WORK.

C. The following spare parts shall be furnished:

1. Provide one set of spare power fuses of each form, voltage, and current rating.

2. Provide 10 spare control and power fuses of each type and rating.

3. Provide 10 panel lamps of each type (form, voltage, and current rating).

4. Provide one of each type of circuit board, as applicable:

a. Control board

b. Power board

c. Diode bridge

d. Transistor module

5. Provide one of each size and type power diode and transistor.

6. Provide one set of any special tool required for maintenance of the VFD units.

2.05 MANUFACTURERS, OR EQUAL

a. Schneider Electric/Square D

b. Eaton

c. GE

d. Yaskawa

e. Siemens

PART 3 - EXECUTION

3.01 MANUFACTURER'S SERVICES

A. General

1. An authorized service representative of the manufacturer shall be present at the Site for 1 day to furnish the services listed below.

2. For the purpose of this Paragraph, a Day is defined as an 8-hour period excluding travel time.

B. The authorized service representative shall supervise the following and shall certify that the equipment and controls have been properly installed, aligned, and readied for operation:

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field testing for proper operation

4. Performing field adjustments such that the equipment installation and operation comply with requirements

5. Document all settings for all VFD's in Record Drawings

C. Instruction of OWNER's Personnel

1. The authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with test equipment.

2. The instruction shall be specific to the VFD models provided.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Training shall include individual sessions for 4 shifts of plant personnel.

5. Proposed training materials shall be submitted for review, and comments shall be incorporated.

6. Training materials shall remain with the trainees.

7. The OWNER may videotape the training for later use with the OWNER's personnel.

3.02 INSTALLATION

A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendations.

B. Programming

1. The CONTRACTOR shall perform programming of drive parameters required for proper operation of the VFDs included in this project.

2. Submit records of programming data in the equipment Technical Manual, including setup and protective settings.

3.03 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer.

B. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

C. Verify proper operation of control logic in every mode of control.

D. Harmonic Analysis

1. The CONTRACTOR shall test the completed installation for actual harmonic distortion at the point of common coupling.

2. Harmonic analysis shall be performed in accordance with IEEE 519 - Harmonic Control and Reactive Compensation of Static Power Converters at unit full load using a harmonic analyzer by Hewlett Packard, or equal

3. Tests shall demonstrate that the harmonic voltage distortion at the 480-volt distribution bus of the panelboard, motor control center, or switchgear serving the VFD is limited to a magnitude of 5 percent of the fundamental, with the isolation transformer in the circuit as indicated and with the maximum number of drives, as permitted by the process, in operation and in conformance with the applicable requirements of IEEE-519.

4. Provide a report that shall include the following:

a. Expected harmonic voltage (THD) through the 35th harmonic, calculated with isolation transformers
b. Actual RMS value and measured percentage of the THD in the field.

END OF SECTION

SECTION 16503
LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of all lighting poles and standards for both the interior and exterior of the project. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All lighting poles and standards shall be manufactured according to the recommended standards as provided by the American Society for Testing Materials.

B. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this specification by reference.

1. American Society for Testing Materials (ASTM).

2. American Association of State Highway Transportation Officers (AASHTO).

C. Acceptable Manufacturers: Products of the following manufacturers which comply with these specifications are acceptable.

1. Poles and Standards
   a. Lithonia

   b. Cooper

   c. Hubbell

   d. Shakespear

   e. Or equal

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of fixture specified. Refer to Division 1 - General Requirements.

B. Drawings shall indicate fixture type and complete details. A complete listing of fixture type, manufacturer and complete catalog number shall be supplied with the shop drawings.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by, or bear the underwriters label where subject to such approval.

B. All poles and standards shall be supplied with base covers and/or nut covers.

C. Concrete bases and pedestals are not a portion of this specification. Refer to the Concrete sections of this specifications.

2.02 POLES AND STANDARDS - STEEL

A. Lighting poles and standards shall be manufactured from steel having the following minimum yield strengths:

1. Pole Shaft: 55,000 psi
2. Base Plate: 36,000 psi
3. Anchor Bolts: 55,000 psi
4. Pipe Tenons: 35,000 psi

B. Where lighting poles are specified with a prime or paint finish, the interior of the pole shall be completely finished with a rust-inhibiting finish.

C. Where Galvanized finish is specified, poles shall be hot dipped in accordance with ASTM-A153.

D. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

E. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

F. Where poles are vertically seamed and welded the weld shall be ground smooth so as not to be readily visible.

G. Steel poles designed for direct burial shall be coated with a bituminous paint below the ground line.

2.03 POLES AND STANDARDS - ALUMINUM

A. Lighting poles and standards shall be manufactured from aluminum having the following strengths:

1. Pole Shaft: 6063-T6
2. Base Plate: 356-T6

3. Pipe Tenons: 6063-T6
4. Anchor Bolts: 55,000 psi

B. Where lighting poles are specified with a painted finish the pole shall be coated with zinc chromate primer or acid etched prior to painting.

C. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

D. Base plates, handhole covers and all welds shall be coated with zinc chromate primer prior to painting.

E. Aluminum poles designed for direct burial shall be coated with a bituminous paint below the ground line.

F. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

2.04 POLES AND STANDARDS - HIGHMAST

A. Lighting poles and standards shall be manufactured from steel having the following minimum yield strengths:

1. Pole Shaft 65,000 psi
2. Base Plate 60,000 psi
3. Anchor Bolts 105,000 psi

B. Where lighting poles are specified with a prime or paint finish, the interior of the pole shall be completely finished with a rust-inhibiting finish.

C. Where galvanized finish is specified, poles shall be hot dipped in accordance with ASTM-A153.

D. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

E. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

F. Where poles are vertically seamed and welded the weld shall be ground smooth so as not to be readily visible.

G. Telescoping joints shall have a minimum overlap of one and one half times the diameter of the pole less 2 inches.

H. Handhole openings will be reinforced with a doubler plate around the handhole opening.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Lighting poles and standards shall be installed per the manufacturers recommended mounting methods and the provisions of the drawings as noted.

B. Where lighting poles are installed with anchor bolts, the area between the pedestal and the base plate shall be grouted and smoothed after the pole has been leveled.

C. The design and specification of concrete anchor bases and pedestals is not a portion of this specification, drawings of anchor bases or pedestals are for conduit detail only.

D. When poles are supplied with a finish coat of paint the supplier shall provide one pint of touch up paint with the poles.

E. When the handhole in the base of the pole is not of sufficient size to allow the splicing of branch circuiting as indicated on the drawings in accordance with NEC fill requirements, then a weather-proof junction box shall be installed flush with finished grade adjacent to the pole. Extend only the conductors required for the adjacent pole from the junction box to the handhole in the pole base. The junction box shall be provided in accordance with the BOXES section of these specifications.

END OF SECTION

SECTION 16960
ELECTRICAL EQUIPMENT ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. The work required under this section of the specifications consist of the start-up testing and inspection of the electrical equipment designated within. All labor and testing equipment which is required shall be provided under this section of the specifications.

1.03 GENERAL

A. The Contractor shall perform the tests, or employ a testing company, as outlined below to insure system acceptance of the electrical equipment as specified in this section.

B. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the technician who performed the tests.

C. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the engineer at least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 1 of this specification.

1.04 QUALITY ASSURANCE

A. The testing and inspection shall comply with all applicable sections of the following codes and standards:

a. American National Standards Institute – ANSI

b. American Society for Testing and Materials – ASTM

c. Association of Edison Illuminating Companies – AEIC

d. Institute of Electrical and Electronics Engineers – IEEE

e. Insulated Power Cable Engineers Association – IPCEA

f. International Electrical Testing Association - NETA Acceptance Testing Specifications

g. National Electrical Code – NEC

h. National Electrical Manufacturers Association – NEMA

i. National Fire Protection Association – NFPA

j. State and Local Codes and Ordinances

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

1.05 DIVISION OF RESPONSIBILITY

A. The contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The contractor is responsible for obtaining and approving a short-circuit analysis and coordination study prepared by the switchgear manufacturer.

E. The contractor shall notify the Engineer prior to commencement of any testing.

F. Any system, material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.

G. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

1.06 SAFETY AND PRECAUTIONS

A. Safety practices shall comply with applicable state and local safety orders as well as with the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the National Fire Protection Association standard NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he has determined that it is safe to do so.

C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

1.07 REPORTS

A. The test report shall include the following sections:

1. Scope of testing

2. Equipment tested

3. Description of test

4. Test results

5. Conclusions and recommendations

6. Appendix, including test forms

B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion. All test reports shall bear the seal of an electrical engineer registered in the project state.

C. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

1.08 TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART 3 - EXECUTION

3.01 EQUIPMENT TO BE TESTED

A. The following equipment shall be tested in accordance with the scopes of work which follow.

1. Dry Type Transformers

2. Low Voltage Switchgear and Switchboards

3. Molded Case Circuit Breakers

4. Motor Control Centers and Motor Controllers

5. Automatic Transfer Switches

6. Emergency Power Supply-Engine Driven

7. Grounding System

8. Cables, Low Voltage, 600 Volts Maximum

9. Ground Fault Systems

10. Surge Arrestors

11. Lighting Control System

3.02 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection

1. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and/or brush major insulating surfaces.

2. Check primary, secondary, and ground connections.

3. Check tap connections and tap changer.

4. Inspect all bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.

5. Inspect insulators, spacers, and windings.

6. Inspect for adequate electrical clearance.

7. Check base or support insulators, including vibration isolation supports.

8. Check accessory devices for condition and proper operation.

9. Verify that the transformers have been provided with adequate spacing for ventilation.

B. Electrical Tests

1. Insulation Resistance Test: Megger transformer windings high to low and ground, low to high and ground, and high and low to ground.

2. Include measured secondary voltage (line-to-line and line-to-ground) for each transformer in the test report. Verify that the taps on all transformers with primary voltages above 600 volts are set to deliver voltage indicated in the Contract Documents with the system in full operation. Secondary voltage readings, at each transformer, phase to phase neutral, and phase load readings shall be recorded and tap

positions of transformer taps noted. This test shall be conducted with a calibrated voltmeter.

3. Each ground rod installation shall be tested after all connections to ground rods are made before grounding conductor connection is made to the transformer. Ground rod installations shall be tested by "fall of potential" measuring method using ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested.

4. Placement of auxiliary electrodes shall be in accordance with operating instructions of test meter, but in no case shall auxiliary current electrodes be placed within 70' of the grounding system being tested. Test data shall indicate placement of auxiliary electrodes with respect to systems being tested, date readings were taken and lowest resistance recorded.

5. Where auxiliary cooling has been provided, verify proper operation of such equipment.

3.03 LOW VOLTAGE SWITCHGEAR AND SWITCHBOARDS

A. Visual and Mechanical Inspection

1. Verify that the contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign materials.

2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.

3. Check for proper travel and alignment of any drawout or plug-in circuit breakers.

4. Check breaker connections to bus.

5. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.

6. Inspect for missing or loose hardware or accessories.

7. Inspect ground bus connections.

8. Operate key and door interlock devices to assure proper operation.

B. Electrical Tests

1. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
2. Energize any space heater circuits to insure proper operations.

C. Check phase rotation with a Biddle phase rotation meter.

D. Instruments and Meter Tests

1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.

3.04 MOLDED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection

1. Inspect cover and case, and check for broken or loose terminals.

2. Operate breaker to check operation.

B. Electrical Tests (400 ampere frame and larger)

1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.

2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.

3. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm switches, and auxiliary switches.

4. Test overcurrent trip device and calibrate to settings provided by the manufacturer’s engineer. Where primary injection testing is specified, test each pole of the breaker individually. Data shall be compared with manufacturer's published data.

a. All trip units shall be tested by primary injection.

b. Static overcurrent trip devices shall be tested per manufacturer's instructions.

c. Test for minimum pick-up current.

d. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).

e. Where short time delay characteristics are provided, test short time pick-up and delay.

f. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.

g. Where ground fault protection is provided, test ground fault pick-up and delay.

h. Check reset characteristics of trip unit.

3.05 MOTOR CONTROL CENTERS AND MOTOR CONTROLLERS

A. Visual and Mechanical Inspection

1. Verify that the contractor has cleaned structure interiors and starter cells of accumulated dust, dirt, oil films, and other foreign material.

2. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.

3. Check mechanical operation of starters for freedom from binding.

4. Check motor circuit protector setting and overload relay heater size against contractor furnished list of motor nameplate full load current values.

B. Electrical Tests

1. Verify operation of each starter.

2. Contact Resistance Test. Ductor across main pole contacts of each breaker or switch with device closed and latched to check for good, low resistance contact.

3. Test each overload relay by current injection through relay heaters. Record heater catalog numbers for each starter and submit list for maintenance. List shall contain circuit number, description of equipment and motor full load amps.

4. Test overcurrent trip device of each circuit breaker trip device by current injection.

3.06 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection

1. Verify that contractor has cleaned enclosure interiors and all components of accumulated of dust, dirt, oil films, and other foreign material.

2. Inspect all electrical and mechanical components for condition and any evidence of defect or failure.

3. Perform inspection checks on individual components as recommended by the manufacturer.

4. Inspect connections for looseness. The electrical contractor shall torque wrench tighten or remake any questionable connections.

5. Inspect for missing or loose hardware or accessories.

6. Check for proper mechanical operation and lubricate, as necessary.

7. Check transfer mechanism for alignment and friction-free operation. Lubricate, as necessary.

8. Check all connecting wiring for condition.

B. Electrical Tests

1. Use test switch, when available, to check the electrical operation of the transfer switch.

2. When a test switch is not available, a failure of the normal source power will be simulated by disconnecting a voltage sensing lead.

3. Test and adjust all sensing relays, and other devices specifically associated with the transfer switch.

4. Contact Resistance Test: Ductor across main pole contacts of power switching circuit breakers, switches or contactor contacts with device closed and latched to check for good, low resistance contact.

3.07 EMERGENCY POWER SUPPLY-ENGINE DRIVEN

A. Visual and Mechanical Inspection

1. Verify that contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign material.

2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.

3. Check output circuit breaker(s) bus connection.

4. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.

5. Inspect for missing or loose hardware or accessories.

6. Inspect grounding system connections.

7. Operate key and door interlock devices to assure proper operation.

8. Inspect all associated systems and circuits for proper operation, including but not limited to the fuel supply system, jacket heater, battery charger, engine mounted control panel, remote monitoring and control panel, emergency cut-off, battery lighting system, exhaust system, radiator system, and ventilator system.

9. Inspect anchoring and vibration isolation systems.

B. Electrical Tests.

1. Insulation resistance test: Megger main poles of output circuit breaker(s) pole-to-pole, from each pole to ground, and across the open contacts of each pole.

2. Contact Resistance Test: Ductor across main pole contacts of output circuit breaker(s) with breaker closed and latched to check for good, low resistance contact.

3. Follow completely the load testing procedures of the latest issue of NFPA-110 for EPS systems, including prior notification of the local inspection authority having jurisdiction. Include all measured data and conditions in the final report. All non-compliance items shall be corrected by the contractor and retested until full compliance with NFPA-110 Level 1 is achieved.

4. Demonstrate load shed operation for both parallel generator and single generator operation.

3.08 GROUNDING SYSTEM

A. Visual and Mechanical Inspection

1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.

2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.

3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests (Small Systems)

1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.

C. Equipment Grounds

1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

D. Test Values

1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm of less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.09 CABLES - LOW-VOLTAGE - 600V MAXIMUM

A. Visual and Mechanical Inspection

1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.

2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.

3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests

1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.

2. Perform continuity test to insure proper cable connection.

C. Test Values

1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

3.10 GROUND-FAULT SYSTEMS (NEC 230-95)

A. Visual and Mechanical Inspection

1. Inspect for physical damage and compliance with drawings and specifications.

2. Inspect neutral main bonding connection to assure:

a. Zero-sequence sensing system is grounded.

b. Ground-strap sensing systems are grounded through sensing device.

c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.

d. Grounded conductor (neutral) is solidly grounded.

3. Inspect control power transformer to ensure adequate capacity for system.

4. Manually operate monitor panels (if present) for:

a. Trip test

b. No trip tests

c. Nonautomatic reset

5. Record proper operation and test sequence.

6. Set pickup and time-delay settings in accordance with the settings provided by the owner/user's electrical engineer.

B. Electrical Tests

1. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.

C. Test Parameters

1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.

2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.

3. Relay pickup value shall be within +/- 10% of setting and in no case greater than 1200A.

3.13 SURGE ARRESTORS

A. Low-Voltage Surge Protection Devices

1. Visual and Mechanical Inspection

a. Inspect for physical damage and compare nameplate data with drawings and specifications.

b. Inspect for proper mounting and adequate clearances.

c. Check tightness of connections by using calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.

d. Check ground lead on each device for individual attachment to ground bus or ground electrode.

3.14 LIGHTING CONTROL SYSTEM

A. Visual and Mechanical Inspection

1. Inspect each device for physical damage.

2. Check for proper labeling of conductors

3. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.

4. Check all cabinet doors, latches, and hinges for proper operation. Adjust, lubricate, and/or repair as required.

B. Electrical Tests

1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.

2. Meggar test all conductors (other than those intentionally grounded) for isolation from ground.

3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.

4. The control unit shall be tested to verify it is in the proper operating condition as detailed in the manufacturer's manual.

5. Each control circuit shall be tested to confirm proper operation of the circuit. Monitor the system with all building equipment energized, such as variable speed controllers, to verify the absence of control inhibiting electrical noise.

END OF SECTION